ACM-PLUS

3-Dimensional Acoustic Current Meter

User Manual

Falmouth Scientific, Inc.

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QUICK-START GUIDE

This quick-start guide encompasses the steps required to deploy the Falmouth Scientific ACM-PLUS 3-Dimensional Acoustic Current Meter right out of its box and retrieve and save the data. Perform the steps below, and if necessary, refer to the referenced page numbers of the manual for more detail. When viewing this manual as a PDF using Adobe Reader, you can click the referenced page numbers to go to the detailed descriptions.

STEP 1: Unpack the ACM-PLUS. (**Page 2-1**.)

STEP 2: Degauss and install the battery pack. (**Page 6-7**.)

STEP 3: Install and run the HardironPlus calibration software. Reference Application Note 2013003, "HardironPlus Calibration for the ACM-PLUS," which is available on the ACM-PLUS Software and Documentation CD included with the ACM-PLUS.

STEP 4: Install ACMProPlus on the computer to which the ACM-PLUS will be connected. (**Page 2-4**.)

STEP 5: Start ACMProPlus. (**Page 2-5**.)

STEP 6: Connect the ACM-PLUS to your computer and determine which COM port it is connected to. Verify that the Firmware Upgrade/RUN switch is switched to RUN. (**Page 2-6**.)

STEP 7: Check the ACM-PLUS. (**Page 3-1**.)

STEP 8: Configure the ACM-PLUS. (**Page 3-3**.)

STEP 9: Deploy the ACM-PLUS. (**Page 3-12**.)

STEP 10: Retrieve and save the data. (**Page 5-1**.)

Operating System Requirements

The ACM-PLUS requires the ACMProPlus software program to configure and operate it. This software runs on Microsoft Windows XP or higher and is supplied with the instrument. In addition, ACMProPlus requires Microsoft .NET Framework 4 to run. This software can be downloaded from Microsoft at http://www.microsoft.com/en-us/download/details.aspx?id=17851.

Text Conventions

This manual uses the following text conventions:

- **Bold** type is used for window and dialog box elements.
- *Italics* type is used for menu names and menu items.
- The ">" symbol is used to represent a sequence of menu item selections. For example, “Choose *File* > *Open*” means select *File* from the menu bar to open the *File* menu, and then choose *Open* from the *File* menu.
- Initial capital letters are used for the names of windows, dialog boxes, screens, and commands.

Customer Service

FSI welcomes your feedback. Please contact FSI customer service to offer any comments or suggestions or to request technical support. FSI can be contacted using any of the following means:

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Cataumet, MA 02534
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SECTION 1: Introduction

The Falmouth Scientific 3-Dimensional Acoustic Current Meter (ACM-PLUS) collects, outputs and stores instantaneous current velocity data in three dimensions along with 3-axis compass data, 2-axis tilt data, temperature data, and data from optional sensors, including an integrated CTD. The current velocity and tilt data can also be output and stored as vector averages over specified averaging intervals. The ACM-PLUS is configured and operated using ACMProPlus, a Microsoft Windows based software program included with the instrument. With ACMProPlus you can configure and deploy the instrument, acquire data in real time and download the data from the instrument's memory. And the real-time data can be viewed on a real-time monitor or a dashboard.

The ACM-PLUS Instrument

The ACM-PLUS measures current velocity in the two horizontal dimensions and the vertical dimension using four acoustic transducers. Included inside the instrument's housing is a 3-axis solid state compass for measuring the Earth's magnetic field and a 2-axis solid state accelerometer for measuring tilt. A temperature sensor for measuring water temperature is located on the top end cap. Along with the optional CTD, the ACM-PLUS can optionally include two auxiliary analog input channels which interface with most DC output sensors, including dissolved oxygen, pH, chlorophyll, light transmission, and others. The ACM-PLUS can be powered from an external DC power supply or from an internal alkaline battery pack. Data can be acquired in real time in ASCII format through an RS-232 or RS-485 serial interface at baud rates up to 115200 bits/sec, or the instrument can be deployed and the data stored in its memory for later retrieval. A single bulkhead connector on the top end cap provides the RS-232 or RS-485 connection and inputs external power. The ACM-Plus is small in size and low in weight and has a depth rating of 200 meters. In addition, a 1.5-ton working strength 316 stainless steel frame is included with pad eyes on the top and bottom for securing to a mooring line, and zinc anodes are attached to the frame to provide cathodic protection. Optionally available is a 5-ton 316 stainless steel frame. In addition, a 7000-meter rated ACM-PLUS is optionally available. Both the 200-meter and 7000-meter ACM-PLUS instruments are shown with a 5-ton frame and a CTD in Figure 1-1, and with a 1.5-ton frame and no CTD in Figure 1-2.

Software and Manual Downloads

ACMProPlus, along with a PDF version of this manual, can be downloaded from the following FSI Web site:

http://www.falmouth.com/sensors/currentmeters.html

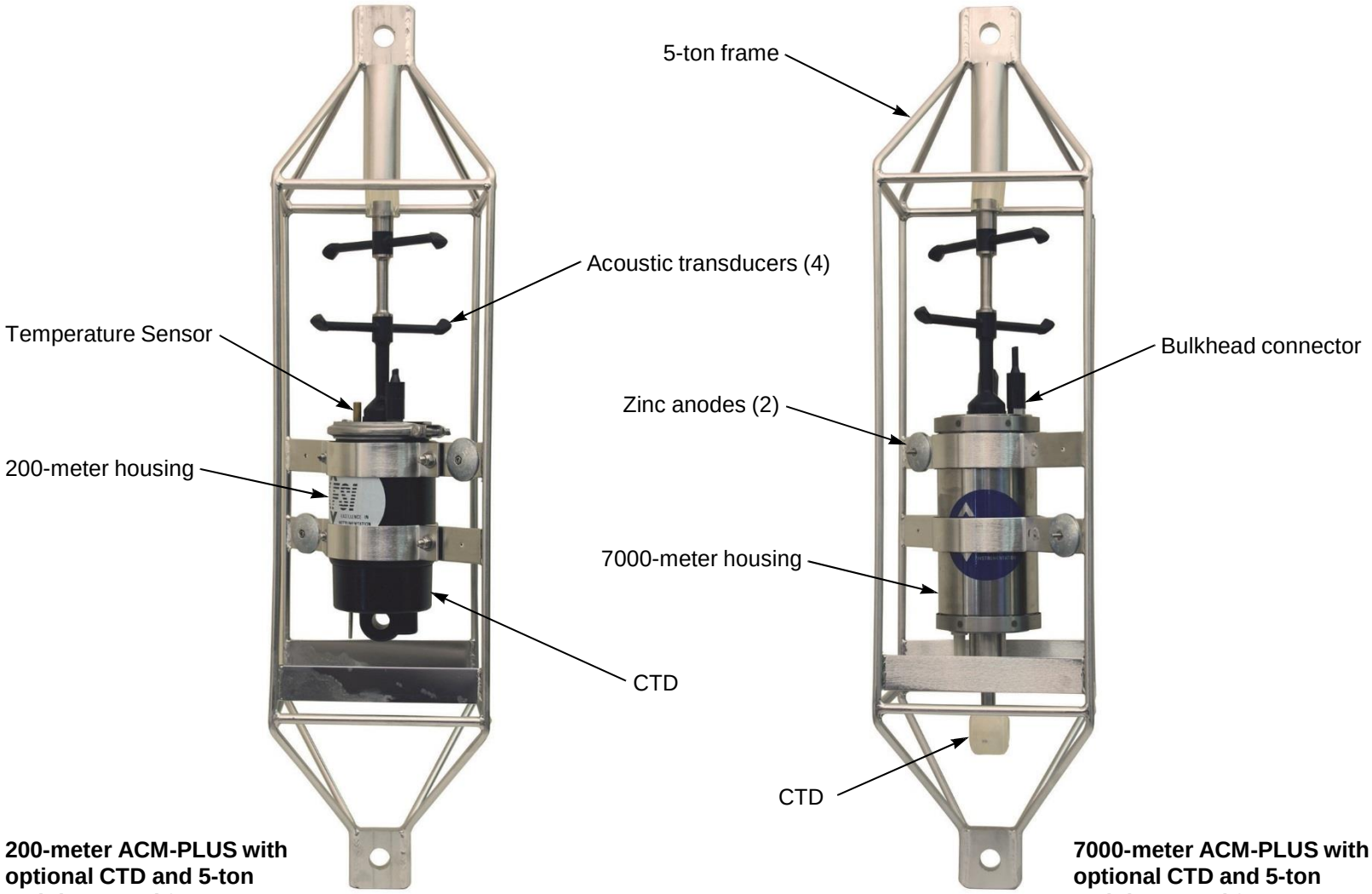


Figure 1-1: ***ACM-PLUS 200-Meter and 7000-Meter Versions with Optional CTD and 5-Ton Stainless Steel Frame***

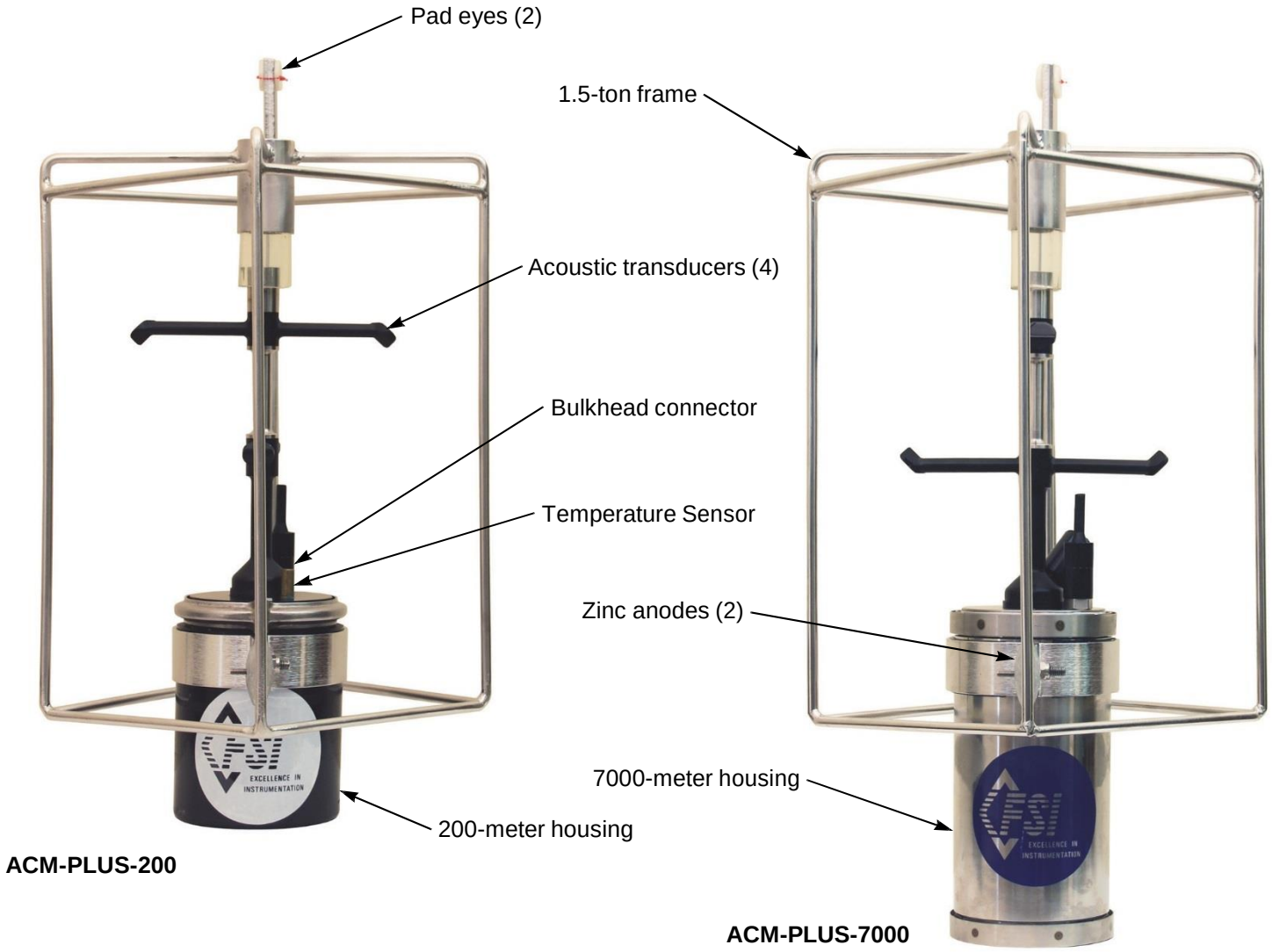


Figure 1-2: ***ACM-PLUS 200-Meter and 7000-Meter Versions with Standard 1.5-Ton Frame***

Specifications

Below are the general specifications for the ACM-PLUS along with the specifications for the velocity, compass, tilt, and temperature sensors.

Note: *These specifications are subject to change without notice.*

General

Power requirements when battery powered (w/o CTD):	5 VDC @ 17.5 mA (1-Hz sample rate) 5 VDC @ 53.3 mA (5-Hz sample rate) 5 VDC @ 87.2 mA (10-Hz sample rate)
Power requirements when battery powered (w/ CTD):	5 VDC @ 76.8 mA (1-Hz sample rate) 5 VDC @ 115.3 mA (5-Hz sample rate) 5 VDC @ 153.3 mA (10-Hz sample rate)
Current draw in sleep mode when battery powered:	0.156 mA (RS-232 serial interface connection) 1.170 mA (RS-485 serial interface connection)
Power requirements when externally powered (w/o CTD):	12 VDC @ 11.1 mA (1-Hz sample rate) 12 VDC @ 31.3 mA (5-Hz sample rate) 12 VDC @ 48.0 mA (10-Hz sample rate)
Power requirements when externally powered (w/ CTD):	12 VDC @ 35.2 mA (1-Hz sample rate) 12 VDC @ 55.0 mA (5-Hz sample rate) 12 VDC @ 72.7 mA (10-Hz sample rate)
Current draw in sleep mode when externally powered:	3.0 mA, approximately
Depth rating:	200 m standard, epoxy resin housing 7000 m optional, 6AL4V titanium housing
Sample rate:	1–10 Hz
Vector averaging period:	1 second to 59 minutes and 59 seconds

Auxiliary analog input channels (2):	0–5.0 VDC
Auxiliary power:	12 VDC at 200 mA max
Frame:	1.5-ton 316 electropolished stainless steel 5-ton 316 electropolished stainless steel
Frame weight in air:	7.5 lb (3.4 kg) for 1.5-ton 14.5 lb (6.6 kg) for 5-ton
Frame weight in water:	6.5 lb (2.9 kg) for 1.5-ton 12.5 lb (5.7 kg) for 5-ton
Bulkhead connector:	Subconn MCBH5F; mates with MCIL5M
Real time clock stability:	±4 ppm/year 0–40°C, 7 ppm/year max
Communication interface:	RS-232 standard; RS-485 optional
Serial baud rate:	9600, 19200, 115200 bits/sec
Data format:	8 data bits, 1 stop bit
Memory:	2 GB minimum SD flash
Battery pack:	5 welded alkaline "D" cells; 5 V @ 10 Ah; optional 5 V @ 20 Ah
Weight in air (w/o battery):	8.0 lb (3.63 kg) with 200-m housing; 9.5 lb (4.31 kg) with CTD 12.0 lb (5.44 kg) with 7000-m housing; 15.0 lb (6.80 kg) with CTD
Weight in water (w/o battery):	4.0 lb (1.81 kg) with 200-m housing; 5.0 lb (2.27 kg) with CTD 6.5 lb (2.95 kg) with 7000-m housing; 9.5 lb (4.31 kg) with CTD
Weight in air (w/ battery):	10.0 lb (4.54 kg) with 200-m housing; 11.5 lb (5.22 kg) with CTD 14.0 lb (6.35 kg) with 7000-m housing; 17.0 lb (7.71 kg) with CTD

Weight in water (w/ battery):

6.0 lb (2.72 kg) with 200-m housing;
7.0 lb (3.18 kg) with CTD

8.5 lb (3.86 kg) with 7000-m housing;
11.5 lb (5.22 kg) with CTD

Velocity

Sensor type: Acoustic

Range: 0–600 cm/s

Accuracy: 2% of reading or 1 cm/s

Resolution: 0.01 cm/s

Compass

Sensor type: 3-axis magnetometer

Accuracy: ±2°

Resolution: 0.01°

Tilt

Sensor type: 2-axis accelerometer

Range: 0–45°

Accuracy: 0.5°

Resolution: 0.01°

Temperature

Sensor type: Semiconductor

Range: -2–35°C

Accuracy: 0.5°C

Resolution: 0.01°C optional

Optional CTD Specifications

Below are the specifications for the conductivity, temperature and pressure sensors of the optional CTD.

Note: *These specifications are subject to change without notice.*

Conductivity

Sensor type:	Inductive cell
Range:	0–7.0 S/m
Accuracy:	±0.002 S/m
Stability:	±0.005 S/m
Resolution:	0.0001 S/m

Temperature

Sensor type:	Platinum resistance
Range:	-5–32°C ITS-90
Accuracy:	±0.01°C
Stability:	±0.0005°C/month
Resolution:	0.001°C

Pressure

Sensor type:	Precision micro-machined silicon transducer
Range:	0–200 dbar or 0–7000 dbar, customer specified
Accuracy:	±0.3% of full scale
Stability:	±0.01% of full scale
Resolution:	0.01% of full scale

SECTION 2: Setting up the ACM-PLUS

Before you can perform most of the functions provided by ACMProPlus, your computer must be connected to the ACM-PLUS through an available serial port. The default serial baud rate is 115200 bits/sec; however, baud rates of 9600 and 19200 bits/sec are also available. This section provides instructions on how to unpack the ACM-PLUS and connect it to your computer, how to install and start ACMProPlus on your computer, and how to configure ACMProPlus for a different serial port and serial baud rate.

Unpacking the ACM-PLUS

Before unpacking the ACM-PLUS, check the shipping container for signs of external damage. If the container appears damaged, report the damage to FSI and to the freight carrier.

When unpacking the ACM-PLUS, inspect all the items for any apparent damage and verify that all the items listed in the packing list are included in the shipment. Report any damage or missing items to FSI.

Battery Pack

An alkaline battery pack is shipped with the ACM-PLUS but is not installed. In addition, the battery pack must be degaussed before installing it. (See "SECTION 6: Disassembling and Reassembling the ACM-PLUS and Installing the Battery Pack," for instructions on how to disassemble the instrument and degauss and install the battery pack.)

Note: *You must degauss the battery pack before installing it.*

Standard Items

The following standard items are included with each delivery:

- ACM-PLUS
- ACM-PLUS Software and Documentation CD
- ACMPlus test cable
- Power supply with AC line cord
- Dummy connector and locking sleeve
- Alkaline battery pack

Optional Items

Optional items are available from FSI and are listed with their part numbers in Table 2-1 below. (See "Customer Service" on page iv for information on how to contact FSI to order any of these items.)

ITEM	FSI PART NUMBER
ACMPlus Test Cable	2ACM-CAB-TST
Power Supply	2ACM-OP-PWR
Alkaline Battery Pack	2ACM-OP-AB
RS-485/RS-232 Converter	3201-RS232-485
USB/Serial Cable	SBT-USC6M
Watertight Shipping Case, 1.5-Ton Frame	2ACM-OP-PSC
Watertight Shipping Case, 5-Ton Frame	1405-421616

Table 2-1: ***Optional Items Available from FSI***

ACMProPlus Overview

ACMProPlus is primarily used to check, to configure and to deploy an ACM-PLUS. In addition, ACMProPlus is used to acquire and display data from the ACM-PLUS in real time, to download data from the instrument's memory, to view the data, and to save the data to a text file. Specifically, the major functions that ACMProPlus allows you to perform are the following:

Check the instrument to establish communications with the ACM-PLUS and to retrieve the instrument serial number, the firmware version number and the calibration date.

Choose the averaged parameters to be output and stored by the instrument by selecting the parameters; namely, the vector averaged current velocity and tilt parameters and the average speed and instrument heading. The selected parameters are output and stored at the end of each averaging interval.

Choose the parameters to be output and stored by the instrument by selecting the parameters; namely, the instantaneous current velocity and tilt parameters, instrument heading, temperature and pressure, sound velocity, and optional parameters. One record of the selected parameters is output and stored along with the selected averaged parameters at the end of each averaging interval.

Set the averaging interval by specifying the period during which the selected vector averaged current velocity and tilt parameters are averaged.

Set the instrument run times by specifying what periods, other than running continuously, during which the instrument is to run and collect data and the delay time and date if the instrument is to begin collecting data at a future time and date. The instrument time and date is set by accepting the time and date from the computer on which ACMProPlus is running.

Prepare the instrument for deployment under its own internal battery power by selecting one of two data acquisition modes—Continuous or Interval —in which the instrument is to run when deployed under its own internal battery power.

Acquire data from the instrument in real time while viewing the data on a real-time monitor or dashboard.

Retrieve and save the data from the instrument after it has been recovered by downloading the data from the instrument's memory and saving the data to a text file.

View saved data by opening a text file that contains data.

Installing ACMProPlus

The ACM-PLUS is configured using ACMProPlus which must be installed on the computer to which the instrument will be connected.

To install ACMProPlus:

1. Exit all programs and turn off any virus protection or screen saver software.
2. Insert the ACM-PLUS Software and Documentation CD into your CD-ROM drive.
3. Using Windows Explorer navigate to the SOFTWARE/ACMProPlus folder. This folder contains ACMProPlus which can also be downloaded from the FSI Web site at http://www.falmouth.com/support/software.html.
4. In the ACMProPlus folder double-click the .exe file.

   The Welcome to the ACMProPlus Setup Wizard screen opens.
5. Click **Next**.

   The License Agreement screen opens.
6. Click the **I accept the agreement** option to accept the terms of the license agreement, and then click **Next**.

   The Select Destination Location screen opens.
7. Click **Next** to install ACMProPlus in the recommended folder, or click **Browse** to select a different folder, and then click **Next**.

   The Select Start Menu Folder screen opens.
8. Click **Next** to install the program shortcut in the Start Menu folder, or click **Browse** to select a different folder, and then click **Next**.

   The Select Additional Tasks screen opens.
9. Select any desired additional icons to create, and then click **Next**.

   The Ready to Install screen opens.
10. Verify the settings are correct, and then click **Install**.

    The Installing screen opens briefly as ACMProPlus is installed, and then the Completing the ACMProPlus Setup Wizard screen opens.
11. Click **Finish** to exit the ACMProPlus Setup Wizard.

Starting ACMProPlus

To start ACMProPlus choose *Start* > *All Programs* > *FSI Applications* > *ACMProPlus*. Or if you elected to create a desktop or Quick Launch icon, you can double-click either one of these to start ACMProPlus. ACMProPlus starts and the ACMProPlus Main window opens as shown in Figure 2-1.

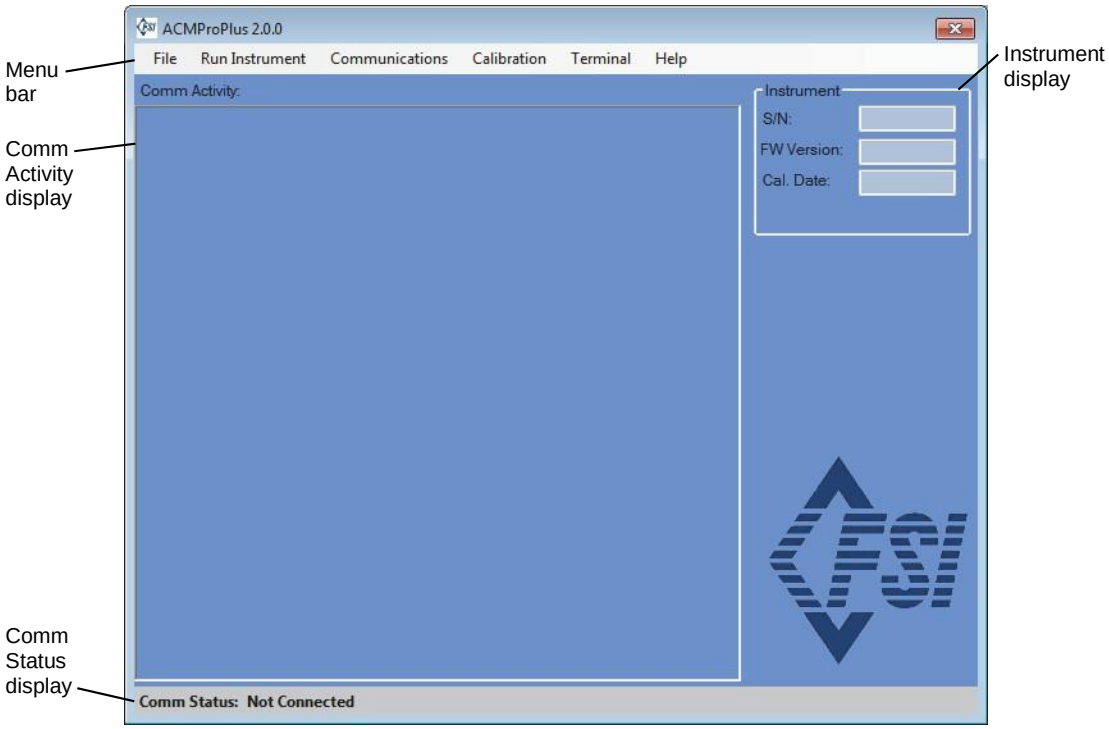


Figure 2-1: ***The ACMProPlus Main Window***

The ACMProPlus Main window includes the Menu bar, the Comm Status display, the Instrument display, and the Comm Activity display. The Menu bar comprises all of the available menus; the Comm Status display indicates the current status of the communications link with the ACM-PLUS; the Instrument display indicates the instrument serial number, the firmware version number and the calibration date; and the Comm Activity display indicates the responses from the ACM-PLUS.

Exiting from ACMProPlus

To exit from ACMProPlus click **X** in the ACMProPlus Main window.

Connecting the ACM-PLUS to Your Computer

The following items are required to connect the ACM-PLUS to your computer:

- An available RS-232 or USB port on the computer.
- ACMPlus test cable (FSI p/n 2ACM-CAB-TST).
- Power supply (FSI p/n 2ACM-OP-PWR).
- RS-485/RS-232 converter (p/n 3201-RS232-485). Required only for an ACM-PLUS that is configured for an RS-485 serial interface connection. Includes a power supply, a gender changer and a serial cable.
- USB/serial cable (FSI p/n SBT-USC6M or equivalent). Required only when the computer has only a USB port available.

Note: *If you will be fabricating your own cable for connecting the ACM-PLUS to your computer, see "APPENDIX A: Bulkhead Connector Wiring."*

Connecting an ACM-PLUS Configured for an RS-232 Serial Interface Connection

An ACM-PLUS configured for an RS-232 serial interface connection is shown set up with a computer in Figure 2-2.

To connect an ACM-PLUS configured for an RS-232 serial connection to your computer:

1. Install the driver for the USB/serial cable in accordance with the instructions provided. This driver is required only if the USB/serial cable will be used to connect to your computer. After installing the driver, connect the cable to a USB port on the computer, and then determine which COM port it is connected to as instructed in "Determining the COM Port used for the USB/Serial Cable" on page 2-10.
2. Disconnect the dummy connector from the bulkhead connector on the ACM-PLUS.
3. Connect the ACMPlus test cable to the bulkhead connector on the ACM-PLUS and to the RS-232 serial port on your computer or to the USB/serial cable.
4. Switch the Firmware Upgrade/RUN switch to RUN.
5. Connect the power supply to the ACMPlus test cable DC power input connector.
6. Connect the AC line cord to the AC power input connector on the power supply and to a 110–240 VAC, 50–60 Hz power source.

Figure 2-2: *The ACM-PLUS Setup with RS-232 Serial Connection*

Connecting an ACM-PLUS Configured for an RS-485 Serial Interface Connection

An ACM-PLUS configured for an RS-485 serial interface connection is shown set up with a computer in Figure 2-3.

To connect an ACM-PLUS configured for an RS-485 serial connection to your computer:

1. Install the driver for the USB/serial cable in accordance with the instructions provided. This driver is required only if the USB/serial cable will be used to connect to your computer. After installing the driver, connect the cable to a USB port on the computer, and then determine which COM port it is connected to as instructed in “Determining the COM Port used for the USB/Serial Cable” on page 2-10.
2. Disconnect the dummy connector from the bulkhead connector on the ACM-PLUS.
3. Connect the ACMPlus test cable to the bulkhead connector on the ACM-PLUS and to the gender changer, and then connect the gender changer to the RS-485 connector of the RS-485/RS-232 converter.
4. Connect the serial cable to the RS-232 connector of the RS-485/RS-232 converter and to the RS-232 serial port on your computer or to the USB/serial cable.
5. Connect the RS-485/RS-232 converter power supply to the RS-485/RS-232 converter DC power input connector and to a 120 VAC, 60 Hz power source.
6. Switch the Firmware Upgrade/RUN switch to RUN.
7. Connect the power supply to the ACMPlus test cable DC power input connector.
8. Connect the AC line cord to the AC power input connector on the power supply and to a 110–240 VAC, 50–60 Hz power source.

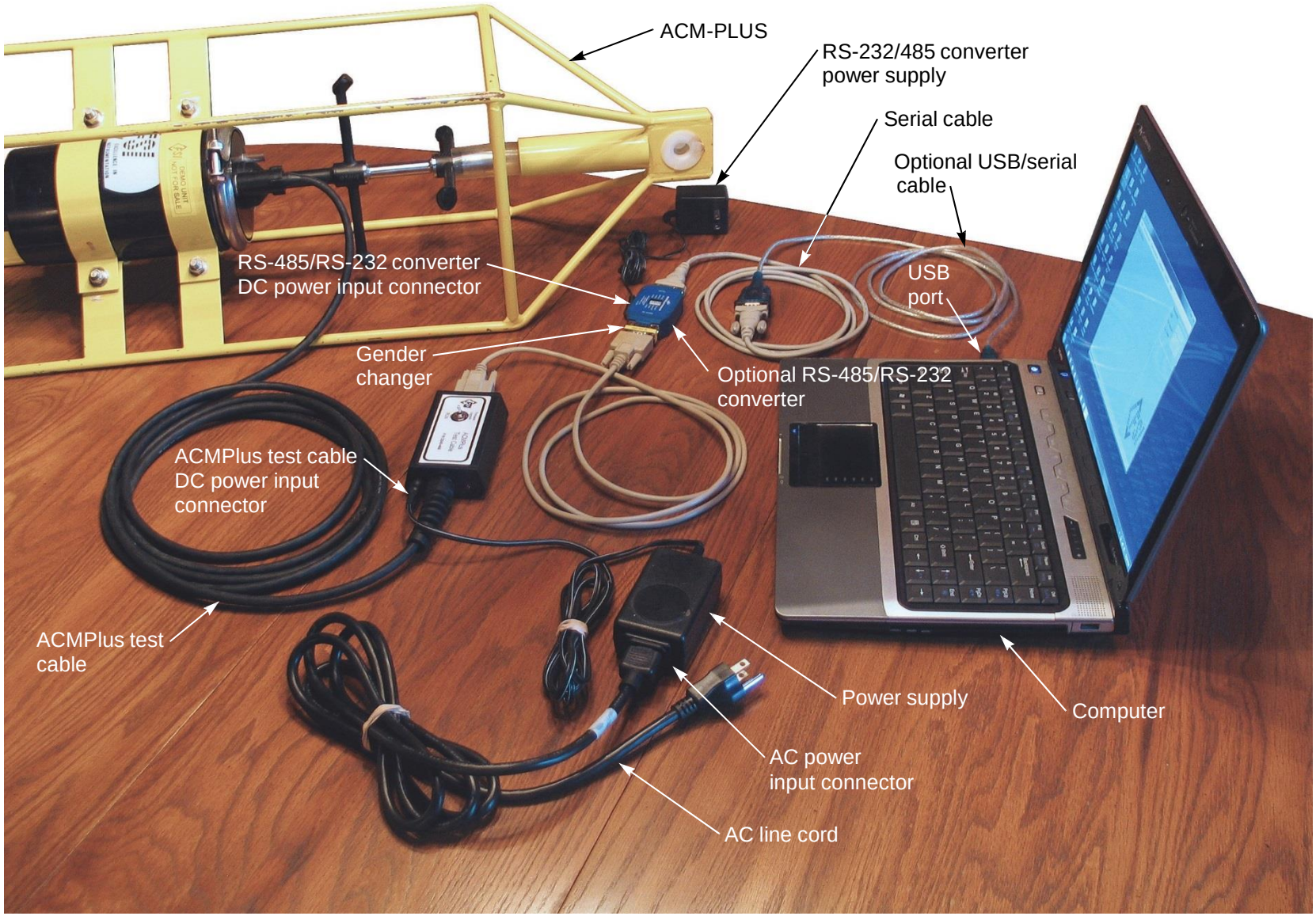


Figure 2-3: ***The ACM-PLUS Setup with RS-485 Serial Connection***

Determining the COM Port used for the USB/Serial Cable

When using a USB/serial cable to connect the ACM-PLUS to your computer, you must determine which COM port it is connected to, as you will be required to select this COM port when communicating with the ACM-PLUS. The COM port is automatically assigned when installing the software for the USB/serial cable.

To find the COM port for the USB/serial cable:

1. Click Windows *Start*.
2. Right-click *Computer*, select *Manage*, and then choose *Device Manager*.
3. Double-click *Ports (COM & LPT)*.
4. The serial port to which the USB/serial cable is connected will be listed along with the cable's manufacturer as shown in the example in Figure 2-4. In this example the connected COM port is COM4.

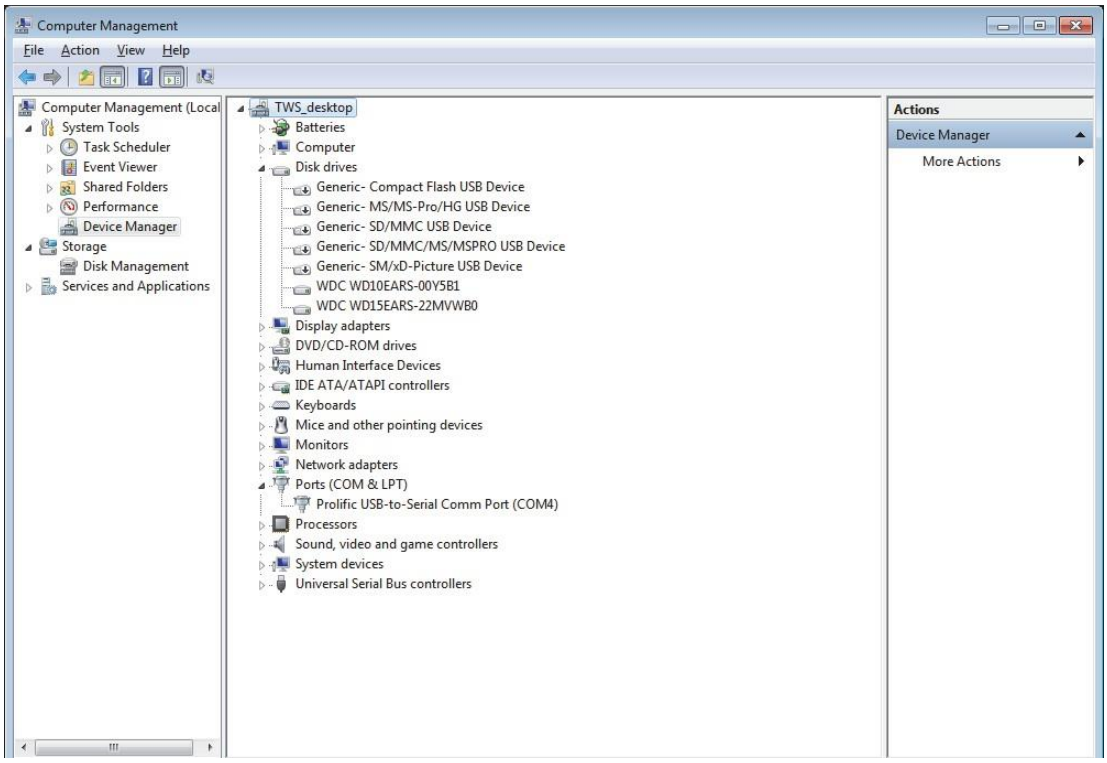


Figure 2-4: *Example COM Port Connection*

Changing the COM Port and Baud Rate

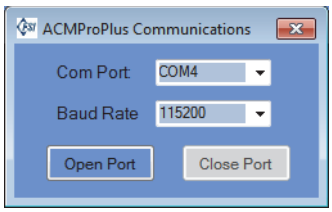
ACMProPlus-Plus allows you to change the serial COM port and baud rate. The available ports depend on your computer. Three baud rates are available: 9600, 19200 and 115200 bits/sec. The default baud rate is 115200 bits/sec.

Changing the Serial COM Port

To change the serial COM port:

1. Choose *Communications* > *ACMProPlus Communications*.

   The ACMProPlus Communications dialog box opens:



2. Select the new serial port from the **Com Port** drop-down list box.
3. Click **Open Port**. If this button is disabled, first click **Close Port**, and then click **Open Port**.
4. The new serial COM port is saved, and the ACMProPlus Communications dialog box closes.

Changing the Serial Baud Rate

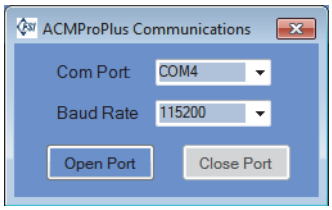
You can change the serial baud rate for the COM port of your computer without affecting the baud rate of the ACM-PLUS that is connected to it, or you can select a different baud rate for the instrument, and ACMProPlus will automatically assign the same baud rate to the COM port.

> ***Note:*** *If you change only the serial baud rate of the COM port of the computer, you will not be able to communicate with the ACM-PLUS until you change it back. You typically should only change the baud rate of the COM port if you are connecting to a different ACM-PLUS for which you know its serial baud rate.*

To change the serial baud rate for the COM port of the computer only:

1. Choose *Communications* > *ACMProPlus Communications*.

   The ACMProPlus Communications dialog box opens:



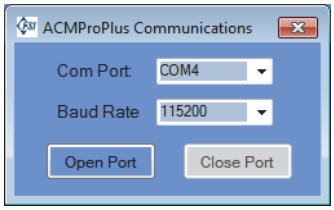
2. Select the new serial baud rate from the **Baud Rate** drop-down list box.
3. Click **Open Port**. If this button is disabled, first click **Close Port**, and then click **Open Port**.

   The new serial baud rate is saved, and the ACMProPlus Communications dialog box closes. The Comm Status display in the ACMProPlus Main window indicates the COM port and the serial baud rate.

To change the serial baud rate for both the ACM-PLUS and the COM port of the computer to which it connects:

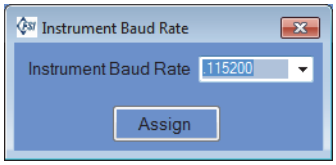
1. Choose *Communications* > *ACMProPlus Communications*.

   The ACMProPlus Communications dialog box opens:



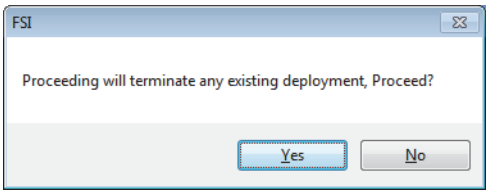
2. Click **Open Port**. If this button is highlighted in gray, it is already open. If this is the case, just click **X**.
3. Choose *Communications* > *InstrumentBaud Rate*.

   The ACMProPlus Communications dialog box opens:



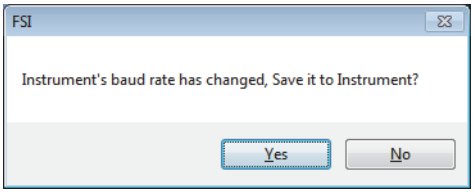
4. Select the new serial baud rate from the **Instrument Baud Rate** drop-down list box.
5. Click **Assign**.

   A window opens warning that any existing deployment will be terminated:



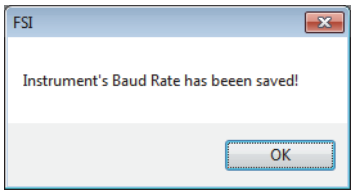
6. Click **Yes**.

   A window opens indicating the baud rate has been changed and whether to save it:



7. Click **Yes**.

   A window opens indicating that the baud rate has been saved:



8. Click **OK**.

Configuring the ACMProPlus Properties

The ACMProPlus properties are configured in the ACMProPlus dialog box shown in Figure 2-5. To open this dialog box choose *File* > *ACMProProperties*. When changing a setting in the ACMProPlus Properties dialog box, a **Save Changes** button appears. Click this button to save the changes, and then click **X** to close the dialog box.

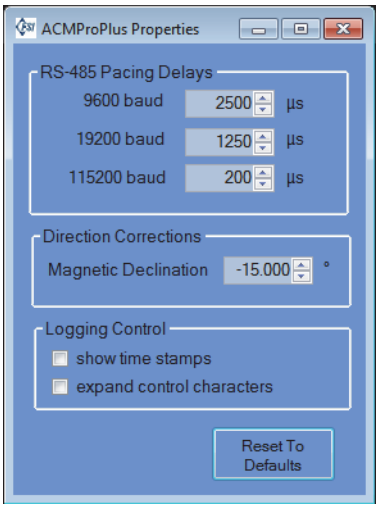


Figure 2-5: ***The ACMProPlus Properties Dialog Box***

In the ACMProPlus dialog box you can adjust the RS-485 pacing delay for an ACM-Plus with an RS-485 serial interface. This adjustment is primarily useful when acquiring data from the ACM-PLUS over a long mooring cable. For very long cables the pacing delay should be increased if communications problems are encountered. There are three adjustments, one for each of the three available serial baud rates. To change a pacing delay, click the up or down arrow in the **9600 baud**, **19200 baud** or **11500 baud** scroll box, whichever corresponds to the baud rate setting of the instrument, or enter the value directly into the scroll box. You can also display the time and date for each line displayed in the Comm Activity display by selecting the **show time stamps** check box. To display carriage return and line feed characters, select the **expand control characters** check box. A carriage return is displayed as "\r" and a line feed as "\n."

SECTION 3: Checking, Configuring and Deploying the ACM-PLUS

This section describes how to check, configure and deploy the ACM-PLUS and includes descriptions of each of the user defined deployment, instrument and data parameters.

Note: *To check and configure the ACM-PLUS, it must be connected to your computer, and the computer must be running ACMProPlus. In addition, the Firmware Upgrade/RUN switch on the ACMPlus test cable must be switched to RUN. (See "SECTION 2: Setting up the ACM-PLUS.")*

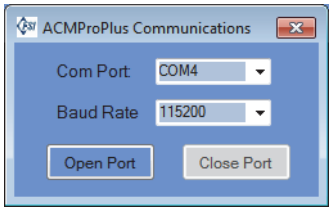
Before you can configure the ACM-PLUS, you should check the instrument. Checking the instrument establishes communications with it and retrieves the instrument's serial number, firmware version number, and calibration date.

Checking the ACM-PLUS

To check the ACM-PLUS:

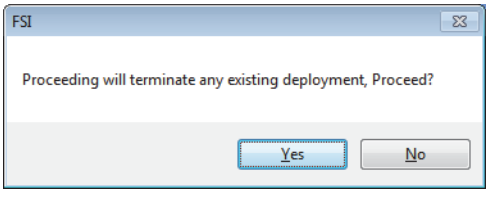
1. Choose *Communications* > *ACMProPlus Communications*.

   The ACMProPlus Communications dialog box opens:



2. Click **Open Port**. If this button is highlighted in gray, it is already open. If this is the case, just click **X**.
3. Choose *Run Instrument* > *Check Instrument*.

   A window opens warning that any existing deployment will be terminated:



4. Click **Yes**.

   ACMProPlus displays the instrument serial number, firmware version number and calibration date in both the Instrument and the Comm Activity displays as shown in Figure 3-1. Also in the Instrument Display, the type of serial interface, RS-232 or RS-485, is displayed. In addition, the Comm Status display indicates when the instrument is sending and receiving information and then indicates Idle when communications are complete.

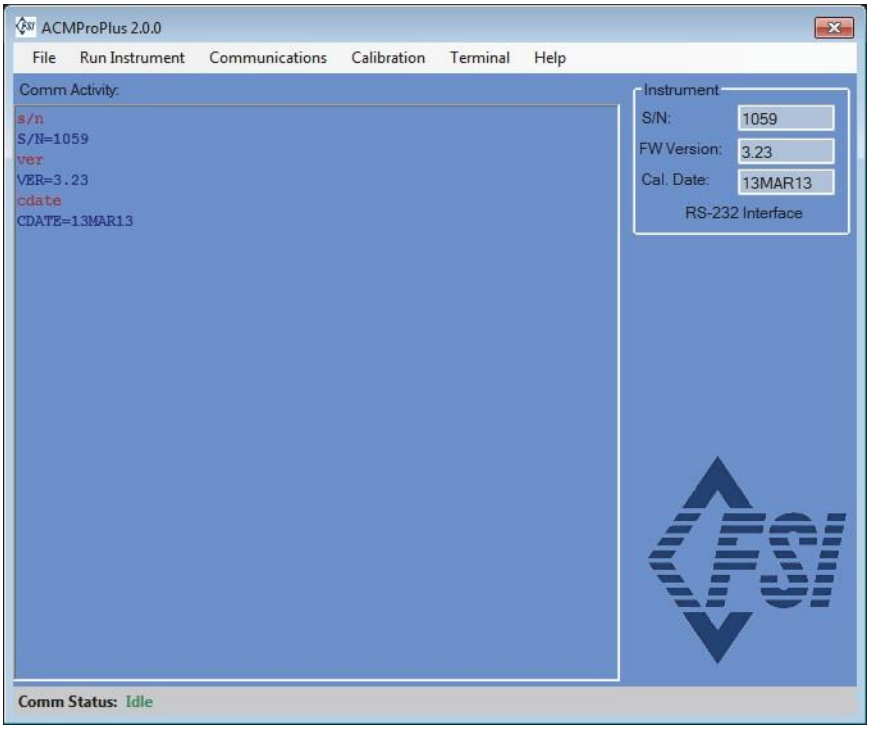


Figure 3-1: ***ACMProPlus Main Window after Checking an ACM-PLUS***

Configuring the ACM-PLUS

Configuring the ACM-PLUS requires that you do the following:

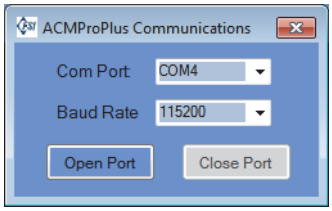
- Verify the instrument information.
- Enter the user defined deployment parameters and synchronize the instrument's time and date.
- Select the instrument parameters, including the data acquisition mode, run times and sampling rate.
- Select the data parameters to be output and recorded by the instrument.

The ACM-PLUS is configured from the Configure and Deploy dialog box shown in Figure 3-2.

To open the Configure and Deploy dialog box:

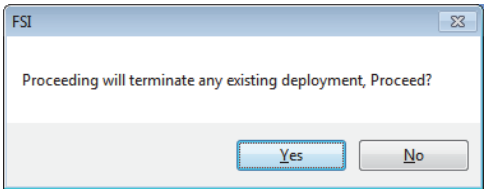
1. Choose *Communications* > *ACMProPlus Communications*.

   The ACMProPlus Communications dialog box opens:



2. Click **Open Port**. If this button is highlighted in gray, it is already open. If this is the case, just click **X**.
3. Choose *Run Instrument* > *Configure and Deploy.*

   A window opens warning that any existing deployment will be terminated:



4. Click **Yes**.

   ACMProPlus first reads the current configuration of the instrument while displaying which items are being read in the Comm Activity display, and then it opens the dialog box.

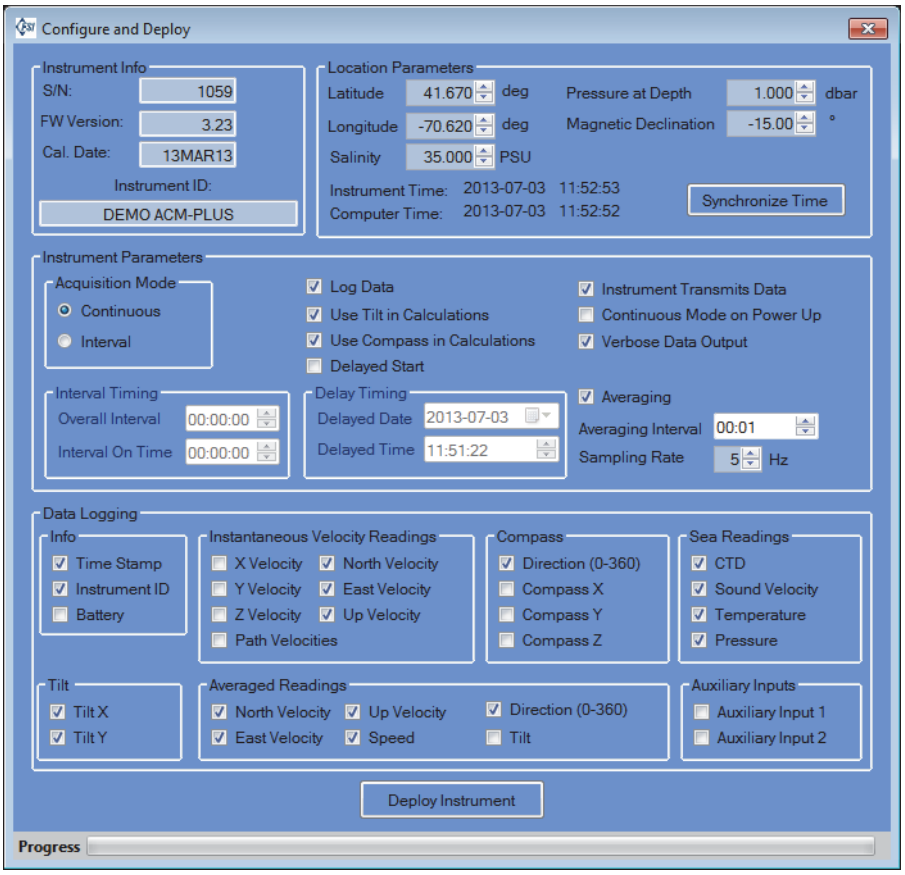


Figure 3-2: ***The Configure and Deploy Dialog Box***

Verifying the Instrument Information and Entering the Instrument ID

The instrument's serial number, firmware version number and calibration date are displayed in the **Instrument Info** area of the Configure and Deploy dialog box. You should verify this information as correct before proceeding with the configuration and deployment of the instrument. In addition, you can enter an instrument ID or change the current instrument ID in the **Instrument ID** text box. This number will be assigned to the ACM-PLUS when it is deployed.

Entering the User Defined Deployment Parameters

The user defined deployment parameters are entered in the **Location Parameters** area of the Configure and Deploy dialog box. Also included in this area is the **Synchronize Time** button. When clicked, this button synchronizes the instrument's time and date to that of the computer to which it is connected. Both the instrument time and the computer time are displayed in the dialog box and are updated every second.

The user defined deployment parameters are the following:

Latitude: The latitude position of the instrument in decimal degrees. The range is -180.000 to 180.000 degrees. A positive value represents north, and a negative value represents south.

Longitude: The longitude position of the instrument in decimal degrees. The range is -180.000 to 180.000 degrees. A positive value represents east, and a negative value represents west.

Salinity: The salinity of the seawater at the deployment site. The value is optional and used for more precise sound velocity calculations. The range is -180.000 to 180.000 PSU.

Pressure at Depth: The water pressure at the deployment site. The value is optional and used for more precise sound velocity calculations. The range is 1.000 to 99.000 dbar.

Magnetic Declination: The angle between magnetic north and true north. The range is -90.00 to 90.00 degrees. Applies to average current direction only.

For each parameter enter the value directly into the scroll box, or click the up or down arrow to select the value. To synchronize the time and date, click **Synchronize Time**.

Selecting the Instrument Parameters

The instrument parameters are selected in the **Instrument Parameters** area of the Configure and Deploy dialog box.

The instrument parameters are the following:

Acquisition Mode: Provides two options for the data acquisition mode of the instrument, **Continuous** and **Interval**. In Continuous mode the instrument, once deployed, continuously stores the selected parameters at the selected Sampling Rate, or if Averaging is selected, at the end of every Averaging Interval. In Interval mode the instrument, once deployed, stores the selected parameters in the same manner as in Continuous mode, but only during the Interval On Time. Otherwise, the instrument is in low power sleep mode.

Interval Timing: Available only if the **Interval** option is selected. Provides **Overall Interval** and **Interval On Time** scroll boxes for setting the instrument run times. The Overall Interval is the time in hours, minutes and seconds between the start of each Interval On Time. The Interval On Time is the time in hours, minutes and seconds beginning at the start of each Overall Interval during which the instrument is on and acquiring data. Otherwise, the instrument is in low power sleep mode.

Note: *If Averaging is selected as described on page 3-7, the Interval On Time should be set to an integer number that is evenly divisible by the Averaging Interval. For example, if the Interval On Time is 10 minutes, the Averaging Interval should be set to 1, 2, 5, or 10 minutes. Otherwise the last averaging interval during the Interval On Time will be shorter than the Averaging Interval setting.*

Delay Timing: Available only if the **Delayed Start** check box is selected. Provides **Delayed Time** and **Delayed Date** scroll boxes for setting the delayed start time and date. The Delayed Date is the date on which the instrument will turn on and begin collecting data at the Delayed Time. The Delayed Time is the time of day on the Delayed Date that the instrument will turn on and begin collecting data.

Log data:	Select to store data to the instrument's memory.
Use Tilt in Calculations:	Select to use the tilt outputs in the current velocity calculations.
Use Compass in Calculations:	Select to use the compass outputs in the current velocity calculations.
Delayed Start:	Select to enable setting of Delayed Date and Delayed Time.
Instrument Transmits Data:	Select to output data when the instrument is deployed. Typically this check box is always selected.
Continuous Mode on Power Up:	Select to have the instrument run in Continuous mode when powered up. This selection is most useful for deployments where serial data is monitored continuously, and the deployment site is subject to power failures.
Verbose Data Output:	Select to enable additional messages to be displayed in the Comm Activity display. Applies to when running in Interval mode or when a delayed start time and date is configured.
Averaging:	Select to include averaging of data. When selected, the **Averaging Interval** scroll box becomes available.
Averaging Interval:	Available only if the **Averaging** check box is selected. The interval in minutes and seconds over which current velocity, tilt and heading are averaged. The range is 00 seconds to 59 minutes and 59 seconds. At the end of every averaging interval, the selected parameters are output on the serial port or logged to memory, or both.
Sampling Rate:	Sampling rate of the instrument. The range is 1 to 10 Hz.

Select or clear the check boxes as required for the deployment. Enter the times directly into the scroll boxes, or separately select the hours, minutes and seconds displays and click the up or down arrow to select the times.

Selecting the Data Parameters to Output and Record

The data parameters to output and record are selected in the **Data Logging** area of the Configure and Deploy dialog box which is composed of seven separate sections as shown in Figure 3-2 on page 3-4. The selectable parameters include both instantaneous and vector averaged current velocity and tilt along with the compass and sensor outputs and the auxiliary analog input channels. Instantaneous current velocity and tilt parameters are current velocity and tilt parameters that are *not* averaged.

> ***Note:*** *For each of the parameter names listed in the following pages, an abbreviated name is included in parenthesis. Except for Instrument ID (INSID), these names are shown in the column headings when viewing downloaded data. (See "Column Heading Definitions" on page 5-6 for the column headings that can be viewed and their definitions.) These abbreviations are also displayed as "Tool Tips" when holding the pointer over the parameter name in the Configure and Deploy dialog box.*

The **Info** section enables selection of the time stamp, the instrument ID and the battery voltage:

Time Stamp (TSTMP): The time and date for each record.

Instrument ID (INSID): The entered instrument ID for all the records.

Battery (BATT): The battery voltage in volts for each record.

The **Instantaneous Velocity Readings** section enables selection of the instantaneous current velocities with the ACM-PLUS oriented "fingers up" or "fingers down" as shown in Figure 3-3:

X Velocity (VX): The X component of the current velocity in cm/sec relative to the direction indicator arrow on the velocity head of instrument.

Y Velocity (VY): The Y component of the current velocity in cm/sec relative to the direction indicator arrow on the velocity head of instrument.

Z Velocity (VZ): The Z component of the current velocity in cm/sec relative to the direction indicator arrow on the velocity head of instrument.

North Velocity (VN): The north/south (+/-) component of the current velocity in cm/sec relative to magnetic north and compensated for the instrument's tilt.

East Velocity (VE): The east/west (+/-) component of the current velocity in cm/sec relative to magnetic north and compensated for the instrument's tilt.

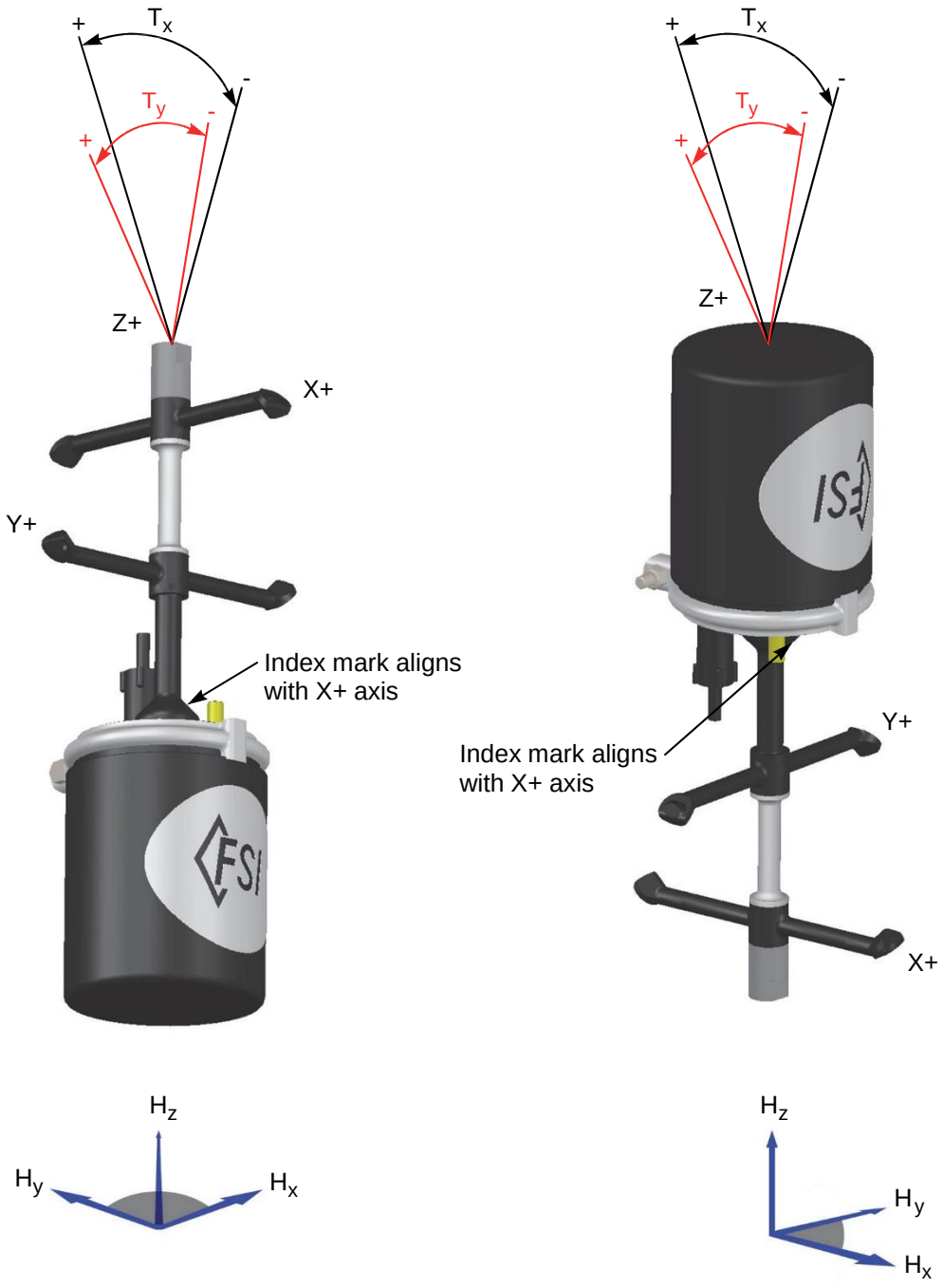


Figure 3-3: ***"Fingers Up" and "Fingers Down" Parameter Orientation Definitions of an ACM-PLUS***

Up Velocity (VUP): The up/down (+/-) component of the current velocity in cm/sec relative to magnetic north and compensated for the instrument's tilt.

Path Velocities (VPATH): The raw velocity data in cm/sec for each of the acoustic paths.

The **Compass** section enables selection of the compass parameters with the ACM-Plus oriented fingers up or fingers down as shown in Figure 3-3:

Direction (0-360) (HDNG): The instrument's heading from 0° to 360° relative to magnetic north.

Compass X (HX): The cosine of the instrument's X axis rotation (H_x) relative to magnetic north.

Compass Y (HY): The cosine of the instrument's Y axis rotation (H_y) relative to magnetic north.

Compass Z (HZ): The cosine of the instrument's Z axis rotation (H_z) relative to magnetic north.

The **Tilt** section enables selection of the tilt outputs with the ACM-Plus oriented fingers up or fingers down as shown in Figure 3-3 on page 3-9:

Tilt X (TX): The X component of the instrument's tilt (T_x) in degrees.

Tilt Y (TY): The Y component of the instrument's tilt (T_y) in degrees.

The **Sea Readings** section enables selection of the sensor outputs:

CTD (CTD): The five CTD outputs of conductivity in mmho/cm, temperature in °C and pressure in dbar. (with optional CTD only)

Sound Velocity (SV): The sound velocity in water in m/sec.

Temperature (STEMP): The water temperature in °C.

Pressure (SPRES): The water pressure in dbar.

The **Averaged Readings** section enables selection of the averaged outputs if the **Averaging** check box is selected:

North Velocity (AVN): The vector averaged north/south (+/-) component of the current velocity in cm/sec relative to magnetic north and compensated for the instrument's tilt.

East Velocity (AVE): The vector averaged east/west (+/-) component of the current velocity in cm/sec relative to magnetic north and compensated for the instrument's tilt.

Up Velocity (AVU): The vector averaged up/down (+/-) vertical component of the current velocity in cm/sec relative to true vertical and compensated for the instrument's tilt.

Speed (AVSPD): The average current speed in cm/sec.

Direction (0–360) (AVDIR): The average heading of the instrument from 0° to 360° relative to magnetic north.

Tilt (ATLT): The vector averaged tilt of the instrument in degrees.

The **Auxiliary Inputs** section enables selection of the two auxiliary analog channel outputs:

Auxiliary Input 1 (AUX1): The Auxiliary Input 1 output.

Auxiliary Input 2 (AUX2): The Auxiliary Input 2 output.

Select or clear the check boxes as required for the deployment.

Deploying the ACM-PLUS

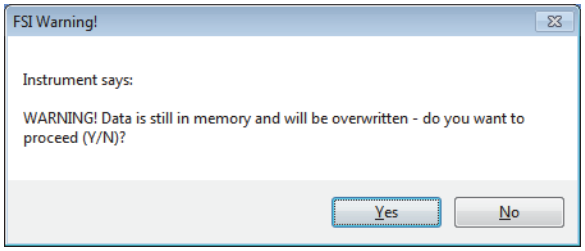
After an ACM-PLUS has been configured, it can be deployed under its own internal battery power, and the data can be stored to the instrument's memory for later retrieval. If necessary, however, before deploying the instrument, replace the battery pack. In addition, the battery pack must be degaussed before installing it. (See "SECTION 6: Disassembling and Reassembling the ACM-PLUS and Installing the Battery Pack," for instructions on how to disassemble the instrument and degauss and install the battery pack.)

> ***Note:*** *Because the ACM-PLUS includes a lithium battery for memory backup and the real time clock (RTC), which provides the instrument's time and date, replacing the battery pack will not affect the instrument's configuration, stored data or time and date settings.*

To Deploy the ACM-PLUS:

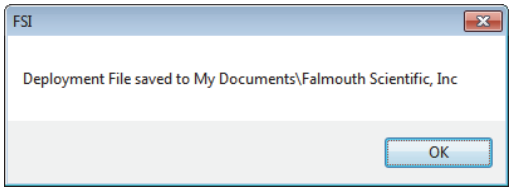
1. Configure the ACM-PLUS as described in "Configuring the ACM-PLUS" on page 3-3.
2. In the Configure and Deploy dialog box, click **Deploy Instrument**.

   A window opens warning that data in memory will be overwritten:



3. If you want to overwrite the data in memory and continue with the deployment, click **Yes**. Otherwise click **X** to abort the deployment without affecting the data.

   The instrument begins the deployment process while a progress bar at the bottom of the Configure and Deploy dialog box indicates the deployment status as shown in Figure 3-4. When the deployment is complete, a window opens informing you that the deployment file has been saved:



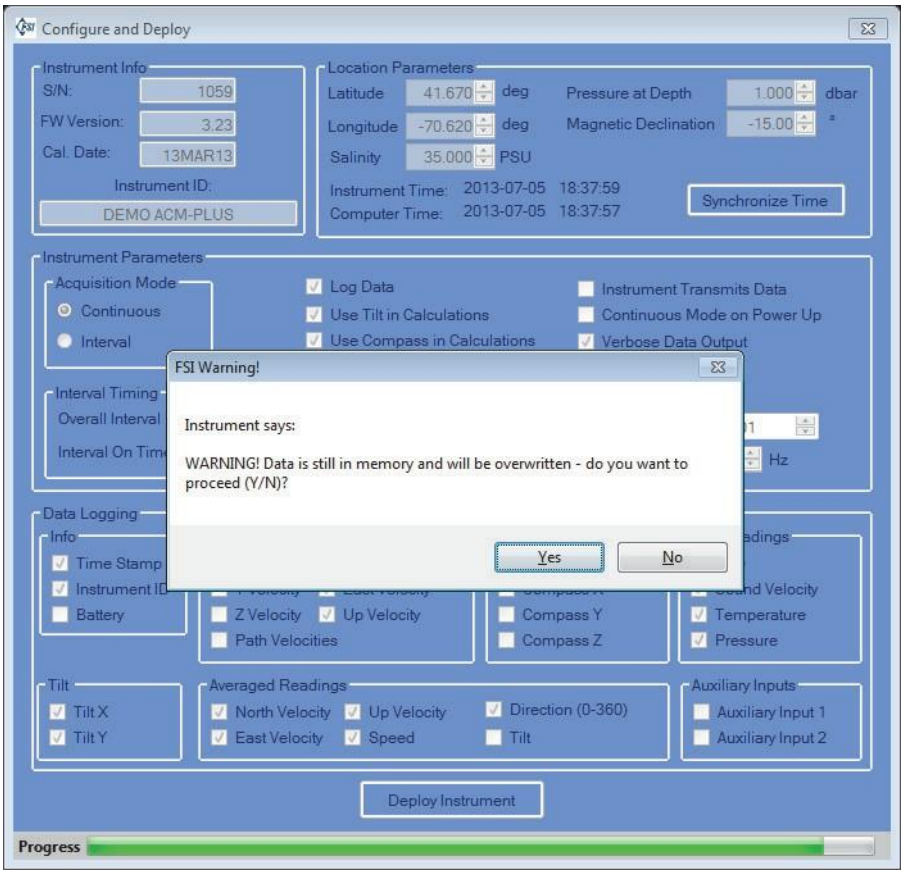


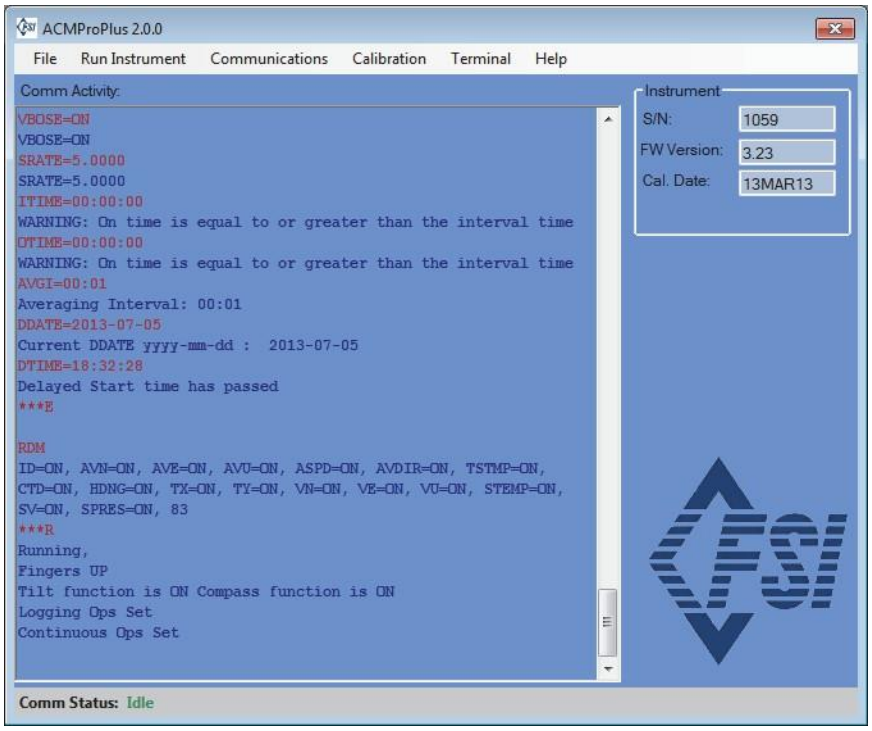
Figure 3-4: ***Progress Bar Indicating the Deployment Status in the Configure and Deploy Dialog Box***

The deployment file is saved to the My Documents/Falmouth Scientific, Inc. folder which was automatically created during the installation of ACMProPlus. The file will have the extension *.dpl*. The file name will be automatically created and will be composed of the instrument ID, the instrument serial number, the date, and the time the file was created in hours, minutes and seconds, as in the following example:

DEMO ACM-PLUS_sn1059_7_7_2013_09_24_07.dpl

4. Click **OK**.

   The ACMProPlus Main window appears with the deployment parameter settings listed in the Comm Activity display:



   Use the scroll bar to view the hidden lines.

5. Click **X** to exit from ACMProPlus, disconnect the ACMPlus test cable and install the dummy plug.

   The ACM-PLUS continues to run and is ready to be deployed.

SECTION 4: Acquiring and Viewing Real-Time Data

After the ACM-PLUS has been configured, it can be run directly from the ACMPlus test cable. Or the ACMPlus test cable can be replaced with a mooring cable, where the maximum length of the cable depends on the selected baud rate of the instrument. In both these configurations data can be acquired and viewed—all in real time, but only in Continuous mode; the Interval mode is not available for real-time data acquisition. Viewing is either on a real-time monitor or on a graphical dashboard.

> ***Note:*** *To acquire and view real-time data, the ACM-PLUS must be connected to your computer, and the computer must be running ACMProPlus. In addition, the Firmware Upgrade/RUN switch on the ACMPlus test cable must be switched to RUN. (See "SECTION 2: Setting up the ACM-PLUS.") If a mooring cable is used instead of the ACMPlus test cable, it must be wired in accordance with "APPENDIX A: Bulkhead Connector Wiring."*

> ***Note:*** *When using a very long mooring cable and an ACM-PLUS with an RS-485 serial interface, it may be required to adjust the pacing delay if communications problems are encountered. (See "Configuring the ACMProPlus Properties" on page 2-14 for instructions on how to change the pacing delay.)*

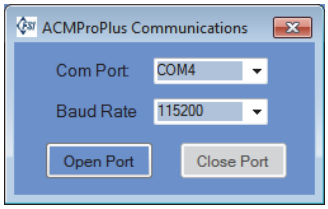
Viewing the Real-Time Monitor

ACMProPlus provides a real-time monitor for viewing real-time data from the ACM-Plus. The monitor allows you to view instantaneous and vector averaged current velocities and tilt, average current speed direction, instrument heading, and instrument time and date. The instrument ID and record number are also displayed, and a high contrast option is available for viewing the real-time monitor in a sunlit environment.

To view the real-time monitor:

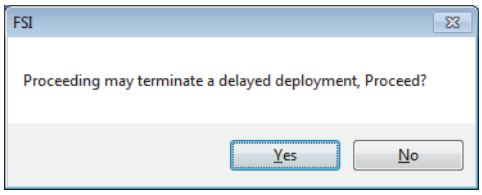
1. Choose *Communications* > *ACMProPlus Communications*.

   The ACMProPlus Communications dialog box opens:



2. Click **Open Port**. If this button is highlighted in gray, it is already open. If this is the case, just click **X**.
3. Choose *Run Instrument > Real Time Monitor.*

   A window opens warning that any existing deployment will be terminated:



4. Click **Yes**.

   The Real Time Monitor window opens as shown in Figure 4-1.

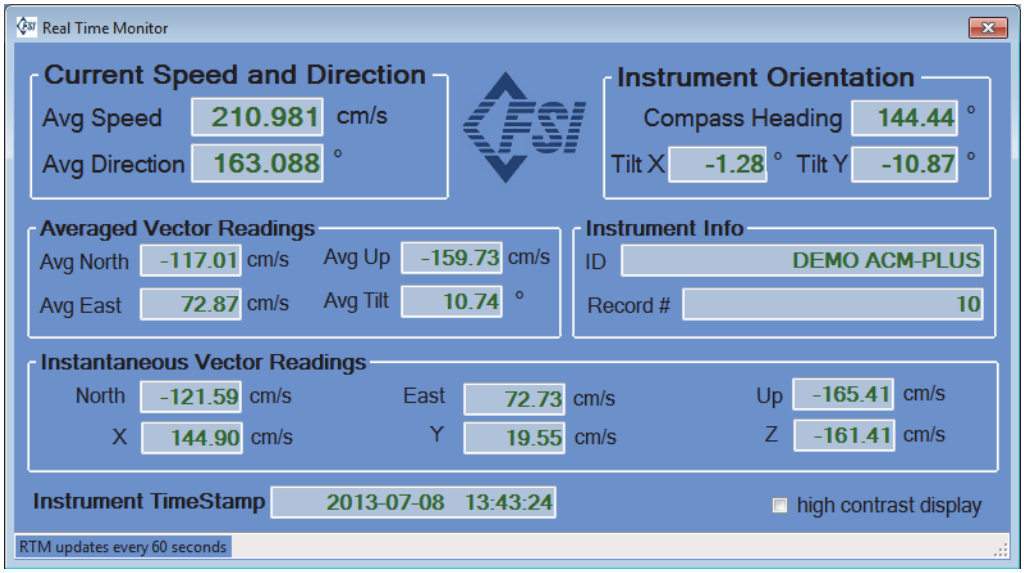


Figure 4-1: ***The Real Time Monitor Window***

The Real Time Monitor window displays in real time the data for all the parameters selected in the Configure and Deploy dialog box when configuring the instrument. Those parameters that have not been selected are not displayed. The displays are updated at the end of every Averaging Interval if the **Averaging** check box was selected in the Configure and Deploy dialog box. The update rate is indicated at the bottom of the Real Time Monitor window. If the **Averaging** check box was not selected, the displays are updated at the sampling rate selected in the **Sampling Rate** scroll box of the Configure and Deploy dialog box.

To view the Real Time Monitor as a high contrast display as shown in Figure 4-2, click **high contrast display**.

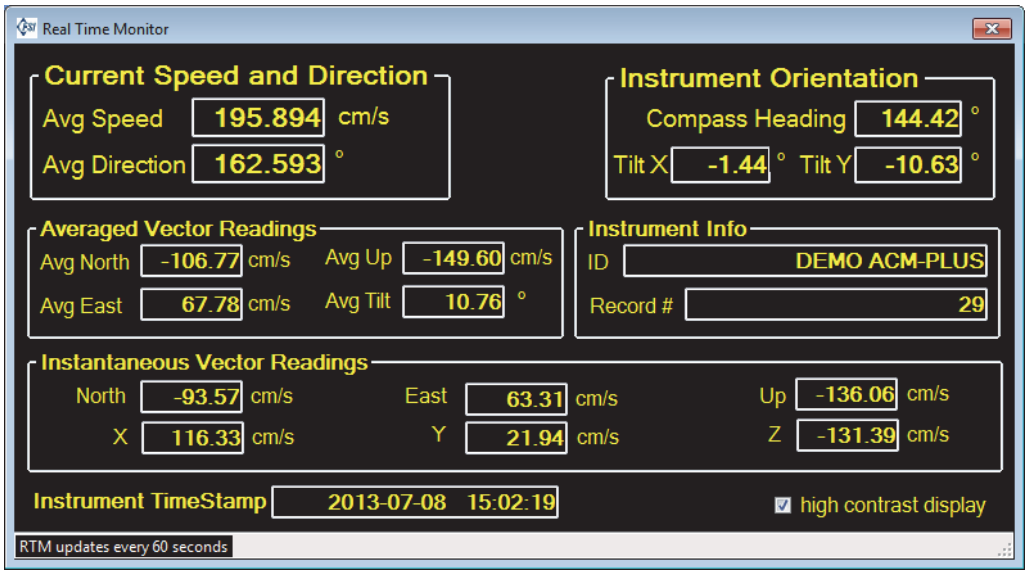


Figure 4-2: ***The Real Time Monitor Window—High Contrast Display***

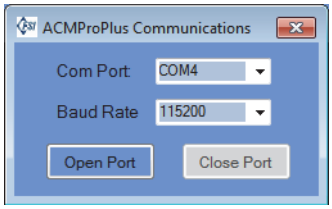
Viewing the Graphical Dashboard

ACMProPlus provides a graphical dashboard for viewing real-time data from the ACM-Plus. The graphical dashboard allows you to view instantaneous current velocities and tilt and average current speed and direction in both analog displays with needle indicators and digital displays. You can choose to display average current speed in cm/sec or knots, and you can map five needle colors to five incrementally higher average current speed ranges. You can also view digital displays of instrument heading; sound speed; optional CTD conductivity, temperature and pressure; sea temperature and pressure; battery voltage; auxiliary analog input channels; and instrument time and date.

To view the graphical dashboard:

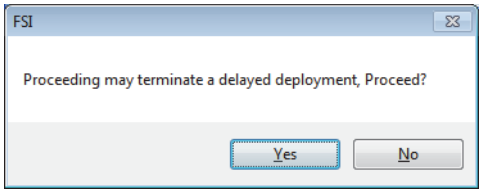
1. Choose *Communications* > *ACMProPlus Communications*.

   The ACMProPlus Communications dialog box opens:



2. Click **Open Port**. If this button is highlighted in gray, it is already open. If this is the case, just click **X**.
3. Choose *Run Instrument* > *Dashboard*.

   A window opens warning that any existing deployment will be terminated:



4. Click **Yes**.

   The Real Time Monitor window opens as shown in Figure 4-3.

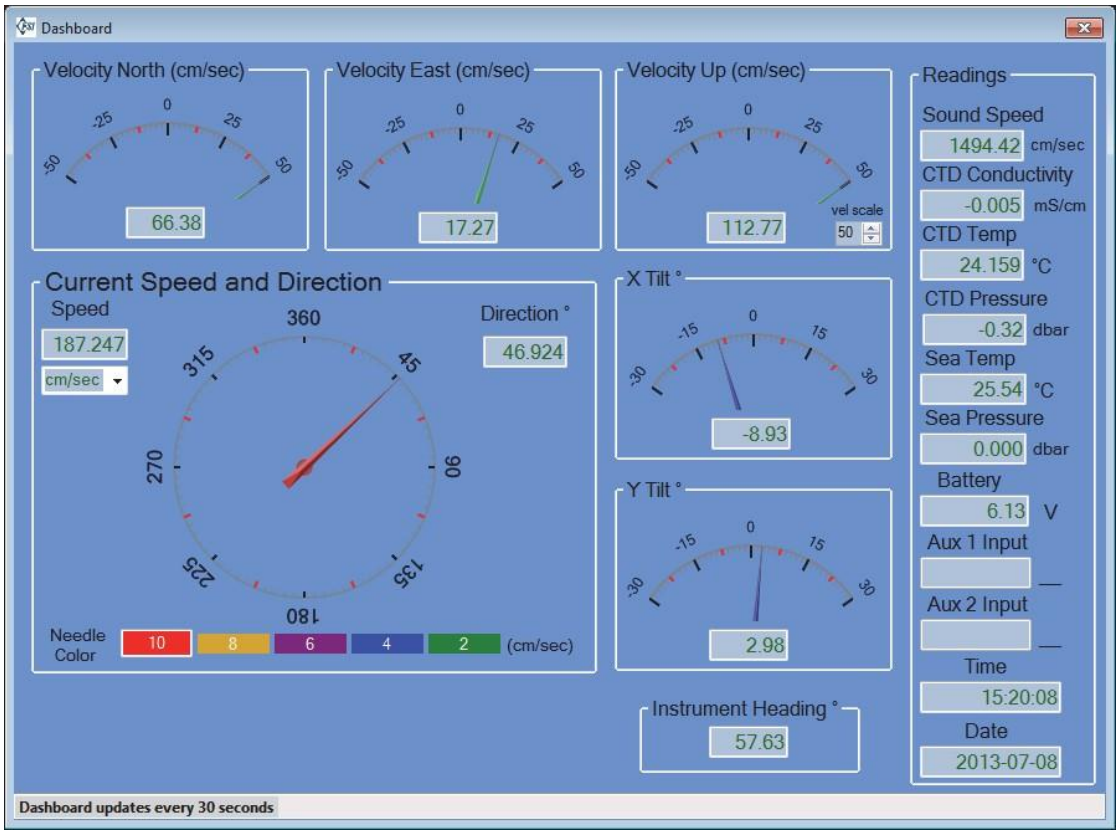


Figure 4-3: ***The Graphical Dashboard***

The Dashboard window displays in real time the data for all the parameters selected in the Configure and Deploy dialog box when configuring the instrument. Those parameters that have not been selected are not displayed. The displays are updated at the end of every Averaging Interval if the **Averaging** check box was selected in the Configure and Deploy dialog box. The update rate is indicated at the bottom of the Dashboard window. If the **Averaging** check box was not selected, the displays are updated at the sampling rate selected in the **Sampling Rate** scroll box of the Configure and Deploy dialog box.

Choosing the Units for Average Current Speed

You can display average current speed in units of cm/sec or knots by choosing which from the drop-down list box in the Dashboard window.

Changing the Full Scale Range for the Instantaneous Current Velocity Displays

The full scale range for the three instantaneous current velocity displays as a group can be changed. To select a different range, click the up or down arrow in the **vel scale** drop-down list box. The new scale is applied immediately. There are five available ranges from 10 cm/sec to 50 cm/sec in 10-cm/sec increments.

Mapping the Needle Color to Average Current Speed Ranges

You can map five needle colors for average current speed to five incrementally higher average current speed ranges. To do this enter the average current speed threshold at which to map the color red in the red box. The needle color will be red for all average current speeds exceeding this threshold. The thresholds for the other colors will be automatically assigned.

SECTION 5: Retrieving, Saving and Viewing Data from the ACM-PLUS

Data that are stored in the ACM-PLUS memory can be retrieved and saved to a text file. When the file is opened in a text editor, the data are shown listed under the parameter names. The file can also be viewed using *View Data File* from the *File* menu. This section describes how to retrieve and save the data from the ACM-PLUS and how to view the data using V*iew Data File*.

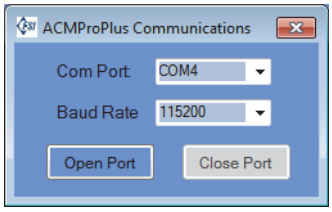
> ***Note:*** *To retrieve data from the ACM-PLUS, it must be connected to your computer, and the computer must be running ACMProPlus. In addition, the Firmware Upgrade/RUN switch on the ACMPlus test cable must be switched to RUN. (See "SECTION 2: Setting up the ACM-PLUS.")*

Retrieving and Saving the Data

To retrieve and save the data from the ACM-PLUS:

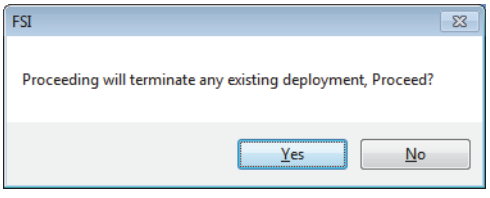
1. Choose *Communications* > *ACMProPlus Communications*.

   The ACMProPlus Communications dialog box opens:



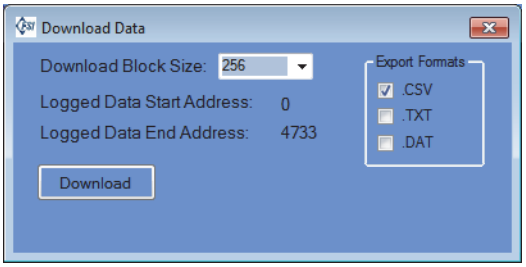
2. Click **Open Port**. If this button is highlighted in gray, it is already open. If this is the case, just click **X**.
3. Choose *Run Instrument* > *Download Data*.

   A window opens warning that any existing deployment will be terminated:



4. Click **Yes**.

   The Download Data dialog box opens:

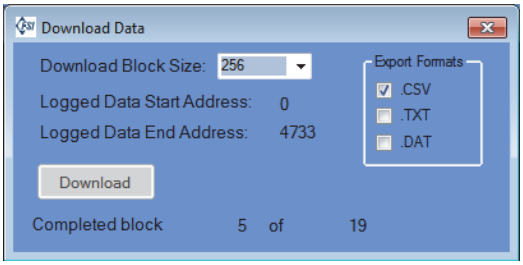


5. Select the block size for the data in the **Download Block Size** drop-down list box. Typically choose the largest block which is 8192. However, if a radio communications link is involved, you typically should choose the smallest block which is 256. The **Logged Data Start Address** and the **Logged Data End Address** together indicate the total number of bytes to be downloaded.

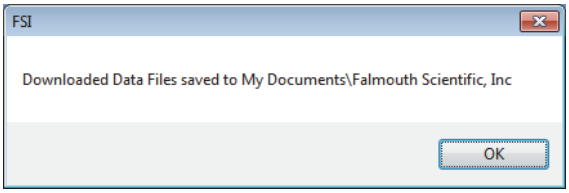
6. Select at least one export format for the downloaded data by selecting one or more of the **.CSV**, **.TXT** or **.DAT** check boxes. A CSV file can be opened in most spreadsheet programs. A TXT file can be opened in most text editors. And a DAT file is an FSI format for use in post processing. This file, too, can be opened in most text editors.

7. Click **Download**.

   The data are downloaded while an indication of the number of blocks downloaded is displayed:



   When all the data are downloaded, a window opens indicating that the data have been saved:



The data files are saved to the My Documents/Falmouth Scientific, Inc. folder which was automatically created during the installation of ACMProPlus. The files will have the extensions *.csv*, *.txt* and *.dat*, depending on which files were selected. The data are also saved to a file of extension *.fsi* is also created. This file is for factory use only. The file names will be automatically created and will be composed of the instrument ID, the instrument serial number, the date, and the time the file was created in hours, minutes and seconds, as in the following examples:

DEMO ACM-PLUS_sn1059_7_7_2013_12_18_35.csv
DEMO ACM-PLUS_sn1059_7_7_2013_12_18_35.txt
DEMO ACM-PLUS_sn1059_7_7_2013_12_18_35.dat
DEMO ACM-PLUS_sn1059_7_7_2013_12_18_35.fsi

8. Click **OK**.

Viewing the Data

The data from a saved data file can be viewed at any time from the *File* menu. It is not necessary to have the ACM-PLUS connected to your computer to view the data.

Before you can view the data, the specific CSV or TXT file that contains the data must be known.

To view the data:

1. Choose *File* > *View Data File*.

   The Open dialog box for data files shown in Figure 5-1 opens. Although many files could be listed, the example in the figure shows one each a CSV file and a TXT file.

2. Click the file you want to view, and then click Open.

   Selecting the CSV file will open a spreadsheet program if it is installed on your computer and if CSV file types are assigned to it. If the file type is not assigned to a program, you will be prompted to assign one. The spreadsheet program will display the data in columns with headings as shown in Figure 5-2. (See "Column Heading Definitions" on page 5-6 for the column headings that can be viewed and their definitions.) In addition, the display includes file header information at the top. You can expand the columns to view hidden characters by dragging the column boundaries at the top.

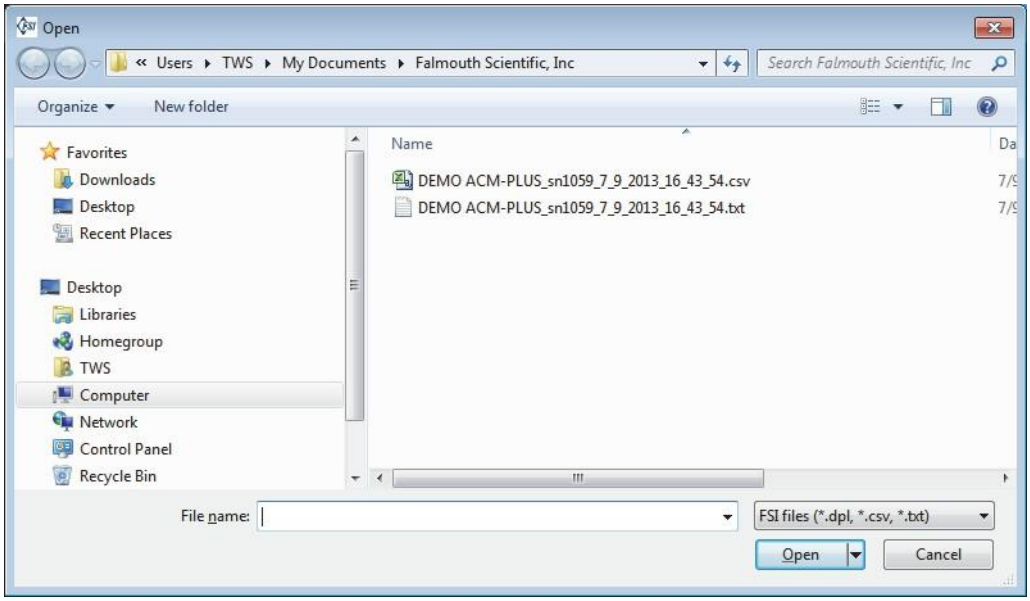
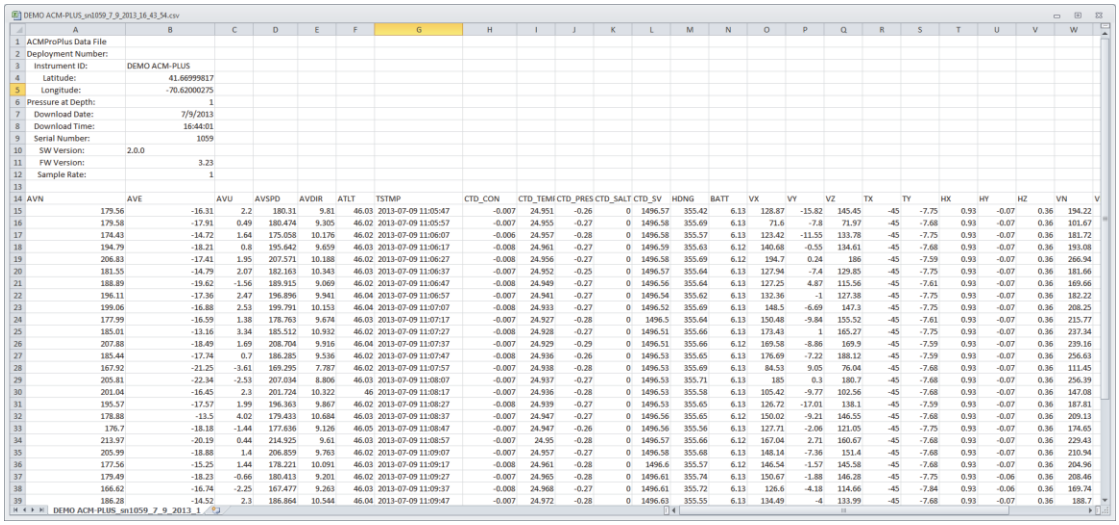


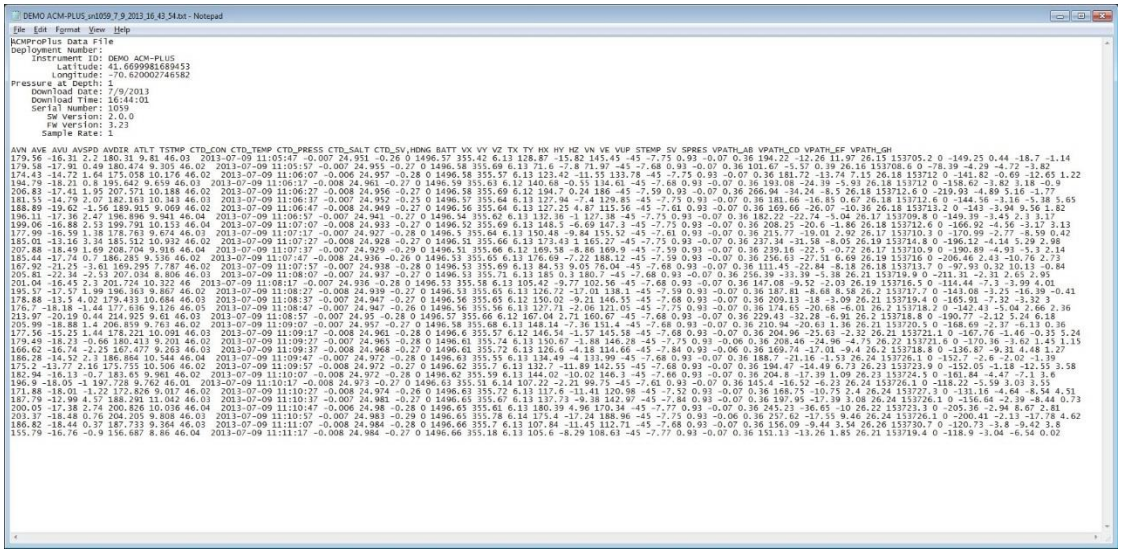
Figure 5-1: ***The Open Dialog Box for Data Files***



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	ACMProPlus Data File																						
2	Deployment Number:																						
3	Instrument ID:	DEMO ACM-PLUS																					
4	Latitude:	41.66999817																					
5	Longitude:	-70.62000275																					
6	Pressure at Depth:	1																					
7	Download Date:	7/9/2013																					
8	Download Time:	16:44:01																					
9	Serial Number:	1059																					
10	SW Version:	2.0.0																					
11	FW Version:	3.23																					
12	Sample Rate:	1																					
13																							
14	AVN	AVE	AVU	AVSPD	AVDIR	ATLT	TSTMP	CTD_CON	CTD_TEMP	CTD_PRES	CTD_SALT	CTD_SV	HDNG	BATT	VX	VY	VZ	TX	TY	HX	HY	HZ	VN	V
15	179.56	-16.31	2.2	180.31	9.81	46.03	2013-07-09 11:05:47	-0.007	24.951	-0.26	0	1496.57	355.42	6.13	128.87	-15.82	145.45	-45	-7.75	0.93	-0.07	0.36	194.22	
16	179.58	-17.91	0.49	180.474	9.305	46.02	2013-07-09 11:05:57	-0.007	24.955	-0.27	0	1496.58	355.69	6.13	71.6	-7.8	71.97	-45	-7.68	0.93	-0.07	0.36	101.67	
17	174.43	-14.72	1.64	175.058	10.176	46.02	2013-07-09 11:06:07	-0.006	24.957	-0.28	0	1496.58	355.57	6.13	123.42	-11.55	133.78	-45	-7.75	0.93	-0.07	0.36	181.72	
18	194.79	-18.21	0.8	195.642	9.659	46.03	2013-07-09 11:06:17	-0.008	24.961	-0.27	0	1496.59	355.63	6.12	140.68	-0.55	134.61	-45	-7.68	0.93	-0.07	0.36	193.08	
19	206.83	-17.41	1.95	207.571	10.188	46.02	2013-07-09 11:06:27	-0.008	24.956	-0.27	0	1496.58	355.69	6.12	194.7	0.24	186	-45	-7.59	0.93	-0.07	0.36	266.94	
20	181.55	-14.79	2.07	182.163	10.343	46.03	2013-07-09 11:06:37	-0.007	24.952	-0.25	0	1496.57	355.64	6.13	127.94	-7.4	129.85	-45	-7.75	0.93	-0.07	0.36	181.66	
21	188.89	-19.62	-1.56	189.915	9.069	46.02	2013-07-09 11:06:47	-0.008	24.949	-0.27	0	1496.56	355.64	6.13	127.25	4.87	115.56	-45	-7.61	0.93	-0.07	0.36	169.66	
22	196.11	-17.36	2.47	196.896	9.941	46.04	2013-07-09 11:06:57	-0.007	24.941	-0.27	0	1496.54	355.62	6.13	132.16	-1	127.38	-45	-7.75	0.93	-0.07	0.36	182.22	
23	199.06	-16.88	2.53	199.791	10.153	46.04	2013-07-09 11:07:07	-0.008	24.933	-0.27	0	1496.52	355.69	6.13	148.5	-6.69	147.3	-45	-7.75	0.93	-0.07	0.36	208.25	
24	177.99	-16.59	1.38	178.763	9.674	46.03	2013-07-09 11:07:17	-0.007	24.927	-0.28	0	1496.5	355.64	6.13	150.48	-9.84	155.52	-45	-7.61	0.93	-0.07	0.36	215.77	
25	185.01	-13.16	3.34	185.512	10.932	46.02	2013-07-09 11:07:27	-0.008	24.928	-0.27	0	1496.51	355.66	6.13	173.43	1	165.27	-45	-7.75	0.93	-0.07	0.36	237.34	
26	207.88	-18.49	1.69	208.704	9.916	46.04	2013-07-09 11:07:37	-0.007	24.929	-0.29	0	1496.51	355.66	6.12	169.58	-8.86	169.9	-45	-7.59	0.93	-0.07	0.36	239.16	
27	185.44	-17.74	0.7	186.285	9.536	46.02	2013-07-09 11:07:47	-0.008	24.936	-0.26	0	1496.53	355.65	6.13	176.69	-7.22	188.12	-45	-7.59	0.93	-0.07	0.36	256.63	
28	167.92	-21.25	-3.61	169.295	7.787	46.02	2013-07-09 11:07:57	-0.007	24.938	-0.28	0	1496.53	355.69	6.13	84.53	9.05	76.04	-45	-7.68	0.93	-0.07	0.36	111.45	
29	205.81	-22.34	-2.53	207.034	8.806	46.03	2013-07-09 11:08:07	-0.007	24.937	-0.27	0	1496.53	355.72	6.13	185	0.3	180.7	-45	-7.68	0.93	-0.07	0.36	256.39	
30	201.04	-16.45	2.3	201.724	10.322	46	2013-07-09 11:08:17	-0.007	24.936	-0.28	0	1496.53	355.58	6.13	105.42	-9.77	102.56	-45	-7.68	0.93	-0.07	0.36	147.08	
31	195.57	-17.57	1.99	196.363	9.867	46.02	2013-07-09 11:08:27	-0.008	24.939	-0.27	0	1496.53	355.65	6.13	126.72	-17.01	138.1	-45	-7.59	0.93	-0.07	0.36	187.81	
32	178.88	-13.5	4.02	179.433	10.684	46.03	2013-07-09 11:08:37	-0.007	24.947	-0.27	0	1496.56	355.65	6.12	150.02	-9.21	146.55	-45	-7.68	0.93	-0.07	0.36	209.13	
33	176.7	-18.18	-1.44	177.636	9.126	46.05	2013-07-09 11:08:47	-0.007	24.947	-0.26	0	1496.56	355.56	6.13	127.71	-2.06	121.05	-45	-7.75	0.93	-0.07	0.36	174.65	
34	213.97	-20.19	0.44	214.925	9.61	46.03	2013-07-09 11:08:57	-0.007	24.95	-0.28	0	1496.57	355.66	6.12	167.04	2.71	160.67	-45	-7.68	0.93	-0.07	0.36	229.43	
35	205.99	-18.88	1.4	206.859	9.763	46.02	2013-07-09 11:09:07	-0.007	24.957	-0.27	0	1496.58	355.68	6.13	148.14	-7.36	151.4	-45	-7.68	0.93	-0.07	0.36	210.94	
36	177.56	-15.25	1.44	178.221	10.091	46.03	2013-07-09 11:09:17	-0.008	24.961	-0.28	0	1496.6	355.57	6.12	146.54	-1.57	145.58	-45	-7.68	0.93	-0.07	0.36	204.96	
37	179.49	-18.23	-0.66	180.413	9.201	46.02	2013-07-09 11:09:27	-0.007	24.965	-0.28	0	1496.61	355.74	6.13	150.67	-1.88	146.28	-45	-7.75	0.93	-0.06	0.36	208.46	
38	166.62	-16.74	-2.25	167.477	9.263	46.03	2013-07-09 11:09:37	-0.008	24.968	-0.27	0	1496.61	355.72	6.13	126.6	-4.18	114.66	-45	-7.84	0.93	-0.06	0.36	169.74	
39	186.28	-14.52	2.3	186.864	10.544	46.04	2013-07-09 11:09:47	-0.007	24.972	-0.28	0	1496.63	355.55	6.13	134.49	-4	133.99	-45	-7.68	0.93	-0.07	0.36	188.7	

Figure 5-2: *CSV File Displayed in Spreadsheet Program*

Selecting the TXT file will open a text editing program if it is installed on your computer and if TXT file types are assigned to it. If the file type is not assigned to a program, you will be prompted to assign one. The text editor will display the data where each data field is separated by a space along with a header as shown in Figure 5-3.



DEMO ACM-PLUS_sn1059_7_9_2013_16_43_54.txt - Notepad

File Edit Format View Help

```
ACMProPlus Data File
Deployment Number:
    Instrument ID: DEMO ACM-PLUS
         Latitude: 41.66999816894653
        Longitude: -70.62000274658203
Pressure at Depth: 1
    Download Date: 7/9/2013
    Download Time: 16:44:01
    Serial Number: 1059
       SW Version: 2.0.0
       FW Version: 3.23
      Sample Rate: 1

AVN AVE AVU AVSPD AVDIR ATLT TSTMP CTD_CON CTD_TEMP CTD_PRESS CTD_SALT CTD_SV HDNG BATT VX VY VZ TX TY HX HY HZ VN VE VUP STEMP SV SPRES VPATH_AB VPATH_CD VPATH_EF VPATH_GH
179.56 -16.31 2.2 180.31 9.81 46.03 2013-07-09 11:05:47 -0.007 24.951 -0.26 0 1496.57 355.42 6.13 128.87 -15.82 145.45 -45 -7.75 0.93 -0.07 0.36 194.22 -12.26 11.97 26.15 153705.2 0 -149.25 0.44 -18.7 -1.14
179.58 -17.91 0.49 180.474 9.305 46.02 2013-07-09 11:05:57 -0.007 24.955 -0.27 0 1496.58 355.69 6.13 71.6 -7.8 71.97 -45 -7.68 0.93 -0.07 0.36 101.67 -5.57 0.39 26.16 153708.6 0 -78.39 -4.29 -4.72 -3.82
174.43 -14.72 1.64 175.058 10.176 46.02 2013-07-09 11:06:07 -0.006 24.957 -0.28 0 1496.58 355.57 6.13 123.42 -11.55 133.78 -45 -7.75 0.93 -0.07 0.36 181.72 -13.74 7.15 26.18 153712 0 -141.82 -0.69 -12.65 1.22
194.79 -18.21 0.8 195.642 9.659 46.03 2013-07-09 11:06:17 -0.008 24.961 -0.27 0 1496.59 355.63 6.12 140.68 -0.55 134.61 -45 -7.68 0.93 -0.07 0.36 193.08 -24.39 -5.93 26.18 153712 0 -158.62 -3.82 3.18 -0.9
206.83 -17.41 1.95 207.571 10.188 46.02 2013-07-09 11:06:27 -0.008 24.956 -0.27 0 1496.58 355.69 6.12 194.7 0.24 186 -45 -7.59 0.93 -0.07 0.36 266.94 -34.24 -8.5 26.18 153712.6 0 -219.93 -4.89 5.16 -1.77
181.55 -14.79 2.07 182.163 10.343 46.03 2013-07-09 11:06:37 -0.007 24.952 -0.25 0 1496.57 355.64 6.13 127.94 -7.4 129.85 -45 -7.75 0.93 -0.07 0.36 181.66 -16.85 0.67 26.18 153712.6 0 -144.56 -3.16 -5.38 5.65
188.89 -19.62 -1.56 189.915 9.069 46.02 2013-07-09 11:06:47 -0.008 24.949 -0.27 0 1496.56 355.64 6.13 127.25 4.87 115.56 -45 -7.61 0.93 -0.07 0.36 169.66 -26.07 -10.36 26.18 153713.2 0 -143 -3.94 9.56 1.82
196.11 -17.36 2.47 196.896 9.941 46.04 2013-07-09 11:06:57 -0.007 24.941 -0.27 0 1496.54 355.62 6.13 132.16 -1 127.38 -45 -7.75 0.93 -0.07 0.36 182.22 -22.74 -5.04 26.17 153709.8 0 -149.39 -3.45 2.3 3.17
199.06 -16.88 2.53 199.791 10.153 46.04 2013-07-09 11:07:07 -0.008 24.933 -0.27 0 1496.52 355.69 6.13 148.5 -6.69 147.3 -45 -7.75 0.93 -0.07 0.36 208.25 -20.6 -1.86 26.18 153712.6 0 -166.92 -4.56 -3.17 3.13
177.99 -16.59 1.38 178.763 9.674 46.03 2013-07-09 11:07:17 -0.007 24.927 -0.28 0 1496.5 355.64 6.13 150.48 -9.84 155.52 -45 -7.61 0.93 -0.07 0.36 215.77 -19.01 2.92 26.17 153710.3 0 -170.99 -2.77 -8.59 0.42
185.01 -13.16 3.34 185.512 10.932 46.02 2013-07-09 11:07:27 -0.008 24.928 -0.27 0 1496.51 355.66 6.13 173.43 1 165.27 -45 -7.75 0.93 -0.07 0.36 237.34 -31.58 -8.05 26.19 153714.8 0 -196.12 -4.14 5.29 2.98
207.88 -18.49 1.69 208.704 9.916 46.04 2013-07-09 11:07:37 -0.007 24.929 -0.29 0 1496.51 355.66 6.12 169.58 -8.86 169.9 -45 -7.59 0.93 -0.07 0.36 239.16 -22.5 -0.72 26.17 153710.9 0 -190.89 -4.93 -5.3 2.14
185.44 -17.74 0.7 186.285 9.536 46.02 2013-07-09 11:07:47 -0.008 24.936 -0.26 0 1496.53 355.65 6.13 176.69 -7.22 188.12 -45 -7.59 0.93 -0.07 0.36 256.63 -27.51 6.69 26.19 153716 0 -206.46 2.43 -10.76 2.73
167.92 -21.25 -3.61 169.295 7.787 46.02 2013-07-09 11:07:57 -0.007 24.938 -0.28 0 1496.53 355.69 6.13 84.53 9.05 76.04 -45 -7.68 0.93 -0.07 0.36 111.45 -22.84 -8.18 26.18 153713.7 0 -97.93 0.32 10.13 -0.84
205.81 -22.34 -2.53 207.034 8.806 46.03 2013-07-09 11:08:07 -0.007 24.937 -0.27 0 1496.53 355.72 6.13 185 0.3 180.7 -45 -7.68 0.93 -0.07 0.36 256.39 -33.39 -5.38 26.21 153719.9 0 -211.31 -2.31 2.65 2.95
201.04 -16.45 2.3 201.724 10.322 46 2013-07-09 11:08:17 -0.007 24.936 -0.28 0 1496.53 355.58 6.13 105.42 -9.77 102.56 -45 -7.68 0.93 -0.07 0.36 147.08 -9.52 -2.03 26.19 153716.5 0 -114.44 -7.3 -3.99 4.01
195.57 -17.57 1.99 196.363 9.867 46.02 2013-07-09 11:08:27 -0.008 24.939 -0.27 0 1496.53 355.65 6.13 126.72 -17.01 138.1 -45 -7.59 0.93 -0.07 0.36 187.81 -8.68 8.58 26.2 153717.7 0 -143.08 -3.25 -16.39 -0.41
178.88 -13.5 4.02 179.433 10.684 46.03 2013-07-09 11:08:37 -0.007 24.947 -0.27 0 1496.56 355.65 6.12 150.02 -9.21 146.55 -45 -7.68 0.93 -0.07 0.36 209.13 -18 -3.09 26.21 153719.4 0 -165.91 -7.32 -3.32 3
176.7 -18.18 -1.44 177.636 9.126 46.05 2013-07-09 11:08:47 -0.007 24.947 -0.26 0 1496.56 355.56 6.13 127.71 -2.06 121.05 -45 -7.75 0.93 -0.07 0.36 174.65 -20.68 -6.01 26.2 153718.2 0 -142.43 -5.04 2.66 2.36
213.97 -20.19 0.44 214.925 9.61 46.03 2013-07-09 11:08:57 -0.007 24.95 -0.28 0 1496.57 355.66 6.12 167.04 2.71 160.67 -45 -7.68 0.93 -0.07 0.36 229.43 -32.24 -6.91 26.2 153718.8 0 -190.77 -2.12 5.24 6.18
205.99 -18.88 1.4 206.859 9.763 46.02 2013-07-09 11:09:07 -0.007 24.957 -0.27 0 1496.58 355.68 6.13 148.14 -7.36 151.4 -45 -7.68 0.93 -0.07 0.36 210.94 -25.63 -2.32 26.21 153720.5 0 -168.69 -2.37 -6.13 0.36
177.56 -15.25 1.44 178.221 10.091 46.03 2013-07-09 11:09:17 -0.008 24.961 -0.28 0 1496.6 355.57 6.12 146.54 -1.57 145.58 -45 -7.68 0.93 -0.07 0.36 204.96 -25.63 -2.32 26.21 153721.1 0 -167.76 -1.46 -0.35 5.24
179.49 -18.23 -0.66 180.413 9.201 46.02 2013-07-09 11:09:27 -0.007 24.965 -0.28 0 1496.61 355.74 6.13 150.67 -1.88 146.28 -45 -7.75 0.93 -0.06 0.36 208.46 -24.96 -4.75 26.22 153721.6 0 -170.36 -1.62 1.45 1.15
166.62 -16.74 -2.25 167.477 9.263 46.03 2013-07-09 11:09:37 -0.008 24.968 -0.27 0 1496.61 355.72 6.13 126.6 -4.18 114.66 -45 -7.84 0.93 -0.06 0.36 169.74 -17.01 -9.4 26.2 153718.8 0 -136.87 -9.31 4.48 1.27
186.28 -14.52 2.3 186.864 10.544 46.04 2013-07-09 11:09:47 -0.007 24.972 -0.28 0 1496.63 355.55 6.13 134.49 -4 133.99 -45 -7.68 0.93 -0.07 0.36 188.7 -21.16 -1.53 26.24 153726.1 0 -152.7 -2.6 -2.02 -1.39
175.2 -13.77 2.16 175.755 10.506 46.02 2013-07-09 11:09:57 -0.008 24.972 -0.27 0 1496.62 355.7 6.13 132.7 -11.89 142.55 -45 -7.68 0.93 -0.07 0.36 194.47 -14.49 6.73 26.23 153723.9 0 -152.05 -1.18 -12.55 3.58
182.94 -16.13 -0.7 183.65 9.961 46.02 2013-07-09 11:10:07 -0.008 24.972 -0.28 0 1496.62 355.59 6.13 144.02 -10.02 146.3 -45 -7.66 0.93 -0.07 0.36 204.8 -17.39 1.09 26.23 153724.5 0 -161.84 -4.47 -7.1 3.6
196.9 -18.05 -1 197.728 9.762 46.01 2013-07-09 11:10:17 -0.008 24.973 -0.27 0 1496.63 355.51 6.14 107.22 -2.21 99.75 -45 -7.61 0.93 -0.07 0.36 145.4 -16.52 -6.23 26.24 153726.1 0 -118.22 -5.59 3.03 3.55
171.88 -18.01 -1.22 172.826 9.017 46.02 2013-07-09 11:10:27 -0.008 24.974 -0.26 0 1496.63 355.72 6.13 117.6 -11.41 120.98 -45 -7.52 0.93 -0.07 0.36 168.75 -10.75 2.4 26.24 153727.3 0 -131.16 -4.64 -8.54 4.51
187.79 -12.99 4.57 188.291 11.042 46.03 2013-07-09 11:10:37 -0.007 24.981 -0.27 0 1496.65 355.67 6.13 137.73 -9.38 142.97 -45 -7.84 0.93 -0.07 0.36 197.95 -17.39 3.08 26.24 153726.1 0 -156.64 -2.39 -8.44 0.73
200.05 -17.38 2.74 200.826 10.036 46.04 2013-07-09 11:10:47 -0.006 24.98 -0.28 0 1496.65 355.61 6.13 180.39 4.96 170.34 -45 -7.77 0.93 -0.07 0.36 245.23 -36.65 -10.26 26.22 153723.3 0 -205.36 -2.94 8.67 2.81
203.37 -18.48 0.76 204.205 9.808 46.03 2013-07-09 11:10:57 -0.007 24.983 -0.29 0 1496.65 355.78 6.14 175.4 -17.24 188.96 -45 -7.75 0.93 -0.06 0.36 257.62 -17.55 9.46 26.24 153726.1 0 -200.41 -2.13 -17.78 4.62
186.82 -18.44 0.37 187.733 9.364 46.03 2013-07-09 11:11:07 -0.008 24.984 -0.28 0 1496.66 355.7 6.13 107.84 -11.45 112.71 -45 -7.68 0.93 -0.07 0.36 156.09 -9.44 3.54 26.26 153730.7 0 -120.73 -3.8 -9.42 3.8
155.79 -16.76 -0.9 156.687 8.86 46.04 2013-07-09 11:11:17 -0.008 24.984 -0.27 0 1496.66 355.18 6.13 105.6 -8.29 108.63 -45 -7.77 0.93 -0.07 0.36 151.13 -13.26 1.85 26.21 153719.4 0 -118.9 -3.04 -6.54 0.02
```

Figure 5-3: *TXT File Displayed in Text Editor*

Column Heading Definitions

The column headings and their definitions for all the parameters that can be viewed are the following:

AVN:	Vector averaged north/south (+/-) current velocity in cm/sec.
AVE:	Vector averaged east/west (+/-) current velocity in cm/sec.
AVU:	Vector averaged up/down (+/-) current velocity in cm/sec.
AVSPD:	Average current speed in cm/sec.
AVDIR:	Average instrument heading in degrees.
ATLT:	Vector averaged tilt in degrees.
TSTMP:	Date in month, day and year and time in hours, min and sec.
CTD_CON:	Conductivity in mmho/cm from an optional CTD.
CTD_TEMP:	Water temperature in °C from an optional CTD.
CTD_PRES:	Water pressure in dbar from an optional CTD.
CTD_SALT:	Salinity in PSU from an optional CTD.
CTD_SV:	Sound velocity in m/sec from an optional CTD.
HDNG:	Instrument heading in degrees.
BATT:	Battery voltage in volts.
VX:	Instantaneous X current velocity in cm/sec.
VY:	Instantaneous Y current velocity in cm/sec.
VZ:	Instantaneous Z current velocity in cm/sec.
TX:	Tilt X in degrees.
TY:	Tilt Y in degrees.
HX:	Compass X.
HY:	Compass Y.
HZ:	Compass Z.
VN:	Instantaneous north/south (+/-) current velocity in cm/sec.
VE:	Instantaneous east/west (+/-) current velocity in cm/sec.
VUP:	Instantaneous up/down (+/-) current velocity in cm/sec.

STEMP:	Water temperature in °C.
SV:	Sound velocity in water in m/sec.
SPRES:	Water pressure in dbar.
AUX1:	Auxiliary Channel 1 output, 0–4095 counts for 0–5 volts.
AUX2:	Auxiliary Channel 2 output, 0–4095 counts for 0–5 volts.
VPATH_AB:	Raw current velocity, transducer A to transducer B.
VPATH_CD:	Raw current velocity, transducer C to transducer D.
VPATH_EF:	Raw current velocity, transducer E to transducer F.
VPATH_GH:	Raw current velocity, transducer G to transducer H.

SECTION 6: Disassembling and Reassembling the ACM-PLUS and Installing the Battery Pack

Before deploying the ACM-PLUS, you must install the battery pack. If you are replacing the battery pack, you must degauss it first. Degaussing minimizes the effects the materials contained in the battery pack have on the instrument's compass. (See "Optional Items" on page 2-2 for the FSI part number for the battery pack.) This section provides instructions on how to disassemble and reassemble the ACM-PLUS and how to degauss and install the battery pack.

Disassembling and Reassembling the ACM-PLUS

To install a battery pack or to perform any repairs or upgrades, the ACM-PLUS must be disassembled by removing and opening the housing and then reassembled by attaching and properly sealing the housing. When disassembling and reassembling the ACM-PLUS, the following tools are required.

- 1/2-inch box wrench
- Spanner wrench, 1/2-inch nut driver or socket wrench with a 1/2-inch socket

Disassembling the ACM-PLUS

To disassemble the ACM-PLUS:

1. Using the 1/2-inch box wrench and the spanner wrench, remove the nut and bolt securing the band clamp.

Figure 6-1: ***Removing the Nut and Bolt Securing the Band Clamp***

2. Remove the band clamp by spreading it slightly and lifting it off the housing.

Figure 6-2: ***Removing the Band Clamp***

3. Using the 1/2-inch box wrench or a socket wrench with a 1/2-inch socket, remove the four self locking nuts and washers securing the two C-clamps, and then remove the clamps.

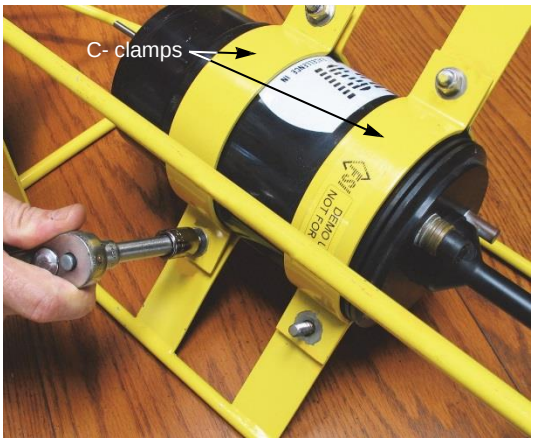


Figure 6-3: ***Removing the Four Self Locking Nuts and Washers***

4. Carefully slide the velocity head out of the plastic tube and lift the housing out of the frame.

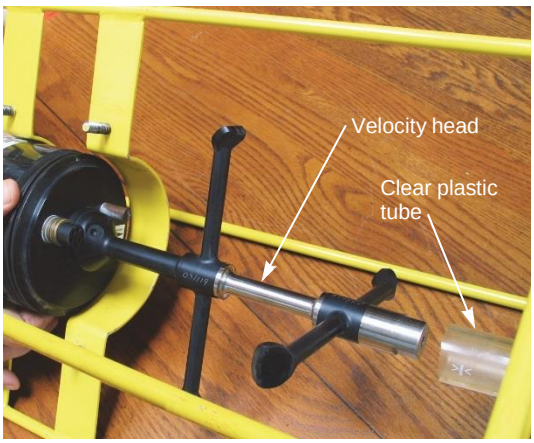


Figure 6-4: ***Lifting the Housing out of the Frame***

5. Carefully pull the end cap straight out of the housing and lay it on its side along with the housing.

Figure 6-5: ***The End Cap Removed from the Housing***

Reassembling the ACM-PLUS

To reassemble the ACM-PLUS, reverse the order of disassembly while also following the procedure for properly sealing the housing when installing the end cap as described in “Properly Sealing the ACM-PLUS” on page 6-4. Before securing the housing to the frame, however, make sure to align the fingers of the velocity head with the frame for maximum protection as shown in Figure 6-6. In addition, provide proper clearance between the top of the velocity head and the frame to ensure that the clear plastic tube is snug.

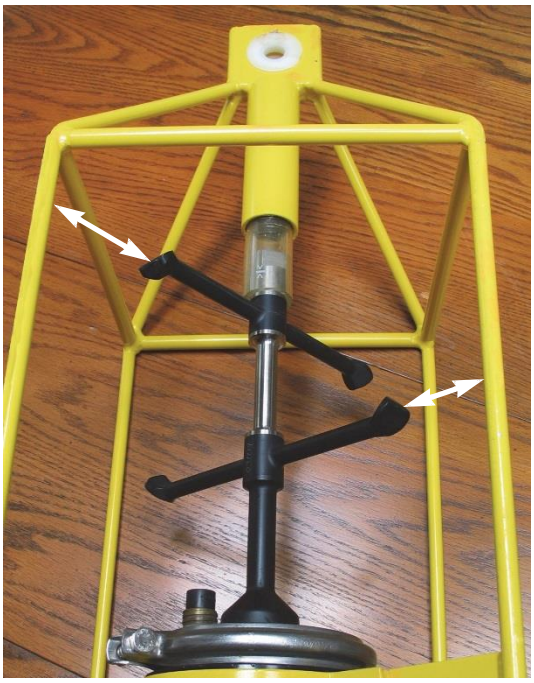


Figure 6-6: ***Fingers of Velocity Head Aligned with Frame***

Properly Sealing the ACM-PLUS

When reassembling the ACM-PLUS, you must properly seal it when installing the end cap. Failure to do so will result in a water leak when the instrument is submerged. A water leak will damage the electronics. When sealing the ACM-PLUS, the following tools and materials are required:

- 1/2-inch box wrench
- Silicone grease
- Spanner wrench, 1/2-inch nut driver or socket wrench with a 1/2-inch socket
- Vice grips or channel locks
- Lint-free cloth or paper towels

Sealing a 200-Meter ACM-PLUS

To seal a 200-meter ACM-PLUS:

1. Inspect both the face seal and the piston seal O-rings on the end cap. If nicks or scratches are found on an O-ring, replace it. When replacing an O-ring, first clean the O-ring groove on the end cap and the O-ring surface on the housing with a lint-free cloth or paper towel. Then lightly lubricate the new O-ring with silicone grease and install it onto the end cap.
2. Lower the end cap into the housing until it rests on it. Be sure the end cap is level with the housing.
3. Press the end cap into the housing until it is flat against the end of the housing as shown in Figure 6-8. It may be required to push it down a few times as back pressure may push it back out. When fully inserted, there should be little or no gap between the end cap and the housing.

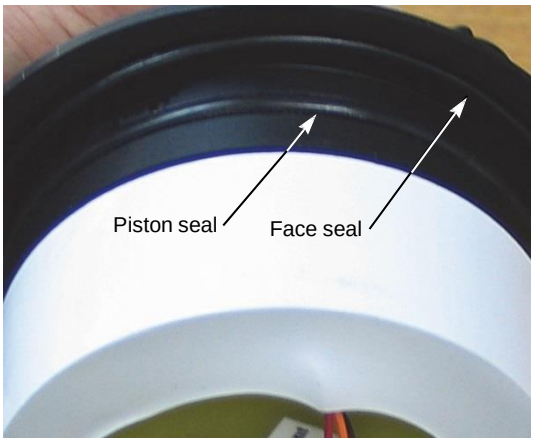


Figure 6-7: ***Checking the Face and Piston Seal O-rings***

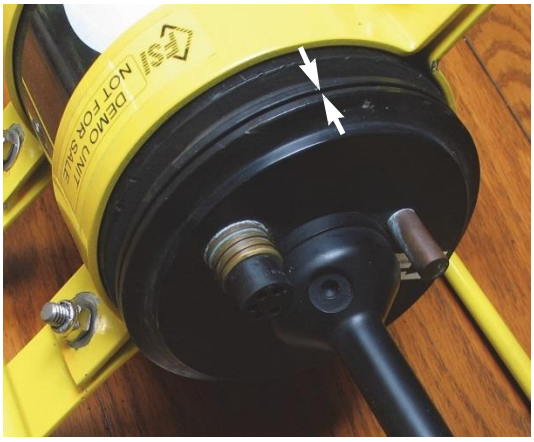


Figure 6-8: ***End Cap Flat against the Housing***

4. Place the band clamp around the housing, straddling the flanges of the end cap and the housing. You may have to spread the clamp slightly to install it, but do not spread it too far, as doing so could deform it.

Figure 6-9: ***Band Clamp around End Cap and Housing***

5. Using one hand, squeeze the band clamp around the flanges and hold it in place while inserting the bolt and loosely attaching the nut. If you find it difficult to hold the clamp in place, use the vice grips or channel locks to grip the two ends of the clamp.

Figure 6-10: ***Bolt and Nut Loosely Attached to Band Clamp***

6. Verify that the band clamp is properly positioned, and then tighten the nut using the 1/2-inch box wrench and the spanner wrench. When properly tightened, the bolt should extend at least 1/2 inch beyond the end of the clamp as shown in Figure 6-11. If you cannot get the bolt to tighten in this manner, the end cap may not be sealed properly. You should remove the clamp and inspect the flanges before continuing.

7. Visually inspect the final assembly.

Figure 6-11: ***Bolt Extended 1/2-Inch Beyond Band Clamp***

Sealing a 7000-Meter ACM-PLUS

The procedure for sealing a 7000-meter ACM-PLUS is similar to that for a 200-meter ACM-PLUS as described in “Sealing a 200-Meter ACM-PLUS” on page 6-4. When sealing the instrument, visually inspect the two O-rings, especially the lower, square O-ring, for any nicks or scratches. As the end cap is seated on the housing, be sure to visually confirm that the lower O-ring is fully seated inside the housing before pressing the end cap firmly past the upper O-ring to seal the end cap flat for clamping shut.

Figure 6-12: *Voss Clamp Loosely Attached*

Instead of a band clamp, the 7000-meter ACM-PLUS uses a Voss clamp. This clamp is shown in Figure 6-12 before tightening and in Figure 6-13 after tightening.

Figure 6-13: *Voss Clamp Tightened*

Installing the Battery Pack

Before installing a new battery pack in the ACM-PLUS, the battery pack must be degaussed. This is especially important for alkaline battery packs, which contain magnetic materials that may adversely affect the performance of the instrument's compass. Degaussing reduces these magnetic effects. To degauss a battery pack a degaussing coil is required, which is simply a large coil that is energized with an AC current. The battery pack is passed through the coil and then slowly removed. Degaussing coils are typically used to eliminate the magnetic fields that affect picture tube alignment and are available from a number of sources including the following:

Butler Tool & Design
641 South Newton Street
Goodland, IN 47948

Telephone: (219) 297-4531
Facsimile: (219) 297-4554

A battery pack is shown being passed through a Butler Tool & Design degaussing coil in Figure 6-14. This degaussing coil is also the unit used in the instructions that follow.

Figure 6-14: ***Degaussing a Battery Pack with a Degaussing Coil***

To degauss a battery pack:

1. With the degaussing coil directly in front of you, hold the battery pack in your hand and pass it through the degaussing coil lengthwise approximately 12 inches to the other side.
2. While pressing the red button, slowly pull the battery pack through the degaussing coil until it is approximately 24 inches in front of the coil. Then release the button.
3. Turn the battery pack around and repeat Steps 1 and 2.

To install a battery pack:

1. Disassemble the ACM-PLUS as described in "Disassembling and Reassembling the ACM-PLUS" on page 6-1.
2. Disconnect the in-line connector if you are replacing an old battery pack.
3. Install the battery pack into the housing, being sure the foam pad is installed first as shown in Figure 6-15.
4. Connect the in-line connector.
5. Reassemble the ACM-PLUS as described in "Disassembling and Reassembling the ACM-PLUS" on page 6-1.

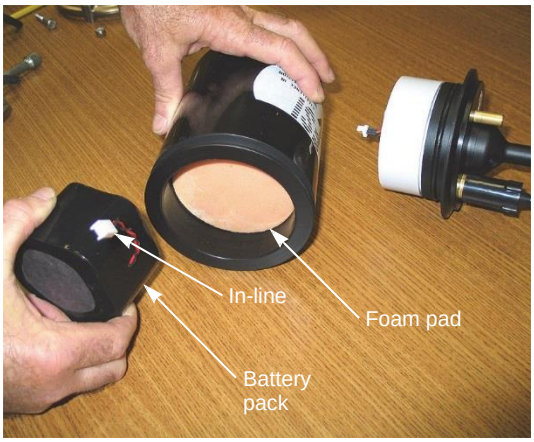


Figure 6-15: ***Installing a Battery Pack***

SECTION 7: Maintenance and Troubleshooting

The ACM-PLUS requires little care other than cleaning and inspection. However, these tasks should be performed after each deployment. This section provides some inspection and cleaning recommendations along with instructions on how to display and save to a file the calibration constants from the instrument's memory and how to load the calibration constants to the instrument's memory from a file. In addition, a troubleshooting guide is provided which will assist in isolating and correcting a few basic operational problems should they occur during setup or deployment.

Cleaning and Inspecting the ACM-PLUS

After each deployment, the ACM-PLUS should be cleaned and carefully inspected as follows:

- Spray the instrument with clean fresh water.
- Inspect the housing, the velocity head and the frame for any damage or corrosion.
- Inspect the cable for any cuts or abrasions.
- Verify that the zinc anodes are secure and are not excessively corroded. Replace any that are.
- Verify that the housing is oriented correctly and is secure.
- Check the connector for signs of corrosion.
- Check around the base of the connector for signs of crevice corrosion.
- Inspect the connector along with its mating connector. If water is present, wash the connectors with alcohol.
- Install the dummy connector.

Displaying and Saving the Calibration Constants To a File

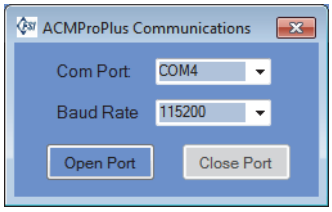
ACMProPlus allows you to display, save and restore the calibration constants of the ACM-PLUS. Should the memory of the instrument become corrupted, the calibration constants provided on the ACM-PLUS Software and Documentation CD can be loaded to the instrument's memory once the problem is corrected.

> ***Note:*** *To display and save the calibration constants to a file, the ACM-PLUS must be connected to your computer, and the computer must be running ACMProPlus. In addition, the Firmware Upgrade/RUN switch on the ACMPlus test cable must be switched to RUN. (See "SECTION 2: Setting up the ACM-PLUS.")*

To display and save the calibration constants to a file:

1. Choose *Communications* > *ACMProPlus Communications*.

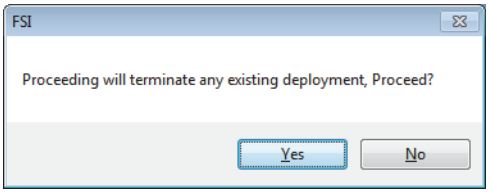
   The ACMProPlus Communications dialog box opens:



2. Click **Open Port**. If this button is highlighted in gray, it is already open. If this is the case, just click **X**.
3. Choose *Calibration* > *Calibration Constants*.

   The Calibration Constants dialog box opens as shown in Figure 7-1.
4. Click **Fetch from Instrument**.

   A window opens warning that any existing deployment will be terminated:



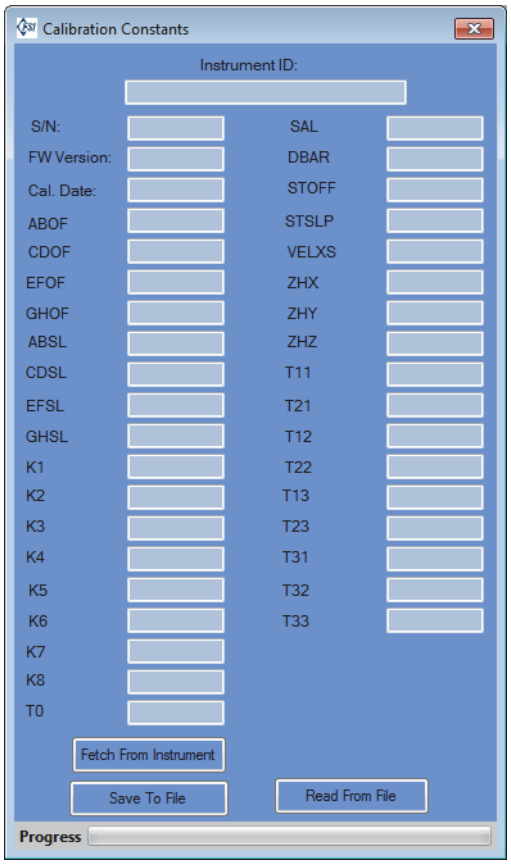


Figure 7-1: ***The Calibration Constants Dialog Box***

5. Click **Yes**.

   The calibration constants are downloaded from the ACM-PLUS while a progress bar at the bottom of the Calibration Constants dialog box indicates the download status. When the downloading is complete, the calibration constants are displayed as shown in Figure 7-2.

6. Click **Save to File**.

   A window opens indicating that the calibration constants have been saved:

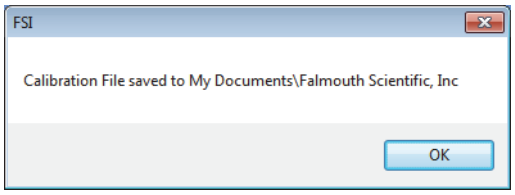


Figure 7-2: ***Calibration Constants Displayed in the Calibration Constants Dialog Box after Downloading from the ACM-PLUS***

The calibration file is saved to the My Documents/Falmouth Scientific, Inc. folder which was automatically created during the installation of ACMProPlus. The file will have the extension *.cal*. The file name will be automatically created and will be composed of the instrument ID, the instrument serial number, the date, and the time the file was created in hours, minutes and seconds, as in the following example:

DEMO ACM-PLUS_sn1059_7_7_2013_16_37_50.cal

7. Click **OK**.
8. Click **X** to close the Calibration Constants dialog box.

Loading the Calibration Constants from a Saved File

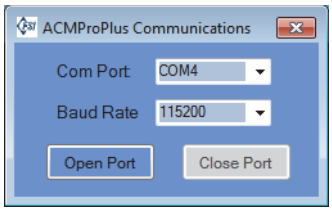
ACMProPlus allows you to load the calibration constants from a file to the ACM-PLUS memory.

> ***Note:*** *To load the calibration constants to the ACM-PLUS memory, the ACM-PLUS must be connected to your computer, the computer must be running ACMProPlus, and the calibration file, a file of extension .cal, must be saved on that computer. In addition, the Firmware Upgrade/RUN switch on the ACMPlus test cable must be switched to RUN. (See "SECTION 2: Setting up the ACM-PLUS.")*

To load the calibration constants from a saved file:

1. Choose *Communications* > *ACMProPlus Communications*.

   The ACMProPlus Communications dialog box opens:

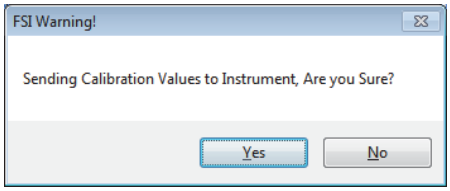


2. Click **Open Port**. If this button is highlighted in gray, it is already open. If this is the case, just click **X**.
3. Choose *Calibration* > *Calibration Constants*.

   The Calibration Constants dialog box opens as shown in Figure 7-1 on page 7-3.
4. Click **Read from File**.

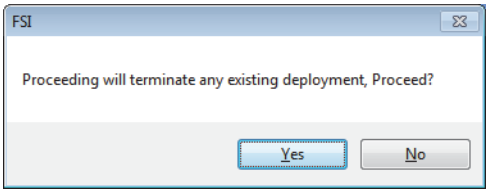
   The Open dialog box for CAL files opens.
5. Select a file, and then click **Open**.
6. In the Calibration Constants dialog box, click **Send To Instrument**.

   An FSI Warning! window opens asking if you are sure:



7. If you are sure, click **Yes**.

   A window opens warning that any existing deployment will be terminated:



8. Click **Yes**.

   The calibration constants are loaded from the file to the ACM-PLUS memory while a progress bar at the bottom of the Calibration Constants dialog box indicates the load status. When the loading is complete, the calibration constants are displayed in the Calibration Constants dialog box as shown in Figure 7-3.

Figure 7-3: ***Calibration Constants Displayed in the Calibration Constants Dialog Box after Loading to the ACM-PLUS***

Troubleshooting Guide

If after setting up or deploying an ACM-PLUS, the instrument does not appear to be working properly, refer to the troubleshooting guide in Table 7-1 for assistance. This guide will help you to quickly isolate a few basic operation problems should they occur. The troubleshooting guide is composed of a list of symptoms with corresponding possible causes and recommended corrective actions. Should the ACM-Plus continue to not operate properly, contact FSI directly. (See "Customer Service" on page iv for information on how to contact FSI.)

Symptom	Possible Cause	Corrective Action
The ACM-PLUS does not communicate with ACMProPlus.	The cable connections are faulty.	Check the cable connections and reconnect the cables.
	Power is not being applied to the instrument from the ACMPlus test cable or the battery.	Apply power or replace the battery pack.
	The cable connections for the communications type, either RS-232 or RS-485, are incorrect.	Use the RS-485/RS-232 converter if the instrument is configured for RS-485 communications.
	The serial baud rate setting for the COM port of the computer is not matched to the baud rate of the instrument.	Change the serial baud rate setting of the COM port of the computer as described in "Changing the Serial Baud Rate" on page 2-11.
	Wrong COM port selected.	Determine which COM port is being used as described in "Determining the COM Port used for the USB/Serial Cable" on page 2-10 and select it.
	The Firmware Upgrade/ RUN switch on the ACMPlus test cable is not switched to RUN.	Switch the Firmware Upgrade/ RUN switch to RUN and cycle power. If battery powered, the battery must be disconnected and then reconnected.

Table 7-1: *Troubleshooting Guide*

Symptom	Possible Cause	Corrective Action
Current velocity data are not what is expected.	Fouling is obstructing the velocity head.	Clean the velocity head with a brush.
	The ACM-PLUS requires a zero velocity calibration.	Perform a zero velocity calibration and verify that the calibration runs without any errors.
	There are water flow obstructions or eddy currents in the vicinity of the instrument.	Change the location of the instrument.
The real-time monitor or the dashboard does not display data.	The instrument is not running in Continuous mode.	Reconfigure the instrument to run in Continuous mode by selecting the Continuous option in the Configure and Deploy dialog box.
There are no CTD data.	CTD data have not been selected for acquisition.	Reconfigure the instrument with the CTD check box selected in the Configure and Deploy dialog box.
The battery life is too short.	The sampling rate is too high.	Reconfigure the instrument with a slower Sampling Rate selected in the Configure and Deploy dialog box.
	The instrument is running in Continuous mode or is running in Interval mode with the Interval On time set too long.	Reconfigure the instrument to run in Interval mode by selecting the Interval option in the Configure and Deploy dialog box and use a shorter Interval On Time setting.
No data are available to download.	The instrument is not configured to log data.	Reconfigure the instrument to log data by selecting the Log Data check box in the Configure and Deploy dialog box.
The instrument time is incorrect.	The instrument time is not synchronized.	Click Synchronize Time in the Configure and Deploy dialog box.

Table 7-1: ***Troubleshooting Guide (Continued)***

Symptom	Possible Cause	Corrective Action
Current direction is not what is expected.	The compass output is not being used in the current direction calculations.	Reconfigure the instrument with the Use Compass in Calculations check box selected in the Configure and Deploy dialog box.
	The local magnetic declination is not set correctly.	Reconfigure the instrument with the correct Magnetic Declination setting in the Configure and Deploy dialog box.
	The compass is not calibrated for the local conditions.	Run the HardironPlus calibration software.
The tilt readings are not what are expected.	The instrument is tilted more than ±30 degrees from vertical.	Orient the instrument such that it is not tilted more than ±30 degrees from vertical.

Table 7-1: ***Troubleshooting Guide (Continued)***

APPENDIX A: Bulkhead Connector Wiring

The ACM-PLUS includes a Subconn MCBH5F bulkhead connector on the top end cap for connecting to a computer and to power. You can fabricate your own cable using a pigtail that mates with the ACM-PLUS's bulkhead connector. This pigtail is a Subconn MCIL5M. Figure A-1 shows the pin orientation of the connector, which is shown face up. Table A-1 shows the required connections from the instrument to the computer; Table A-2, the required connections from the instrument to the power supply.

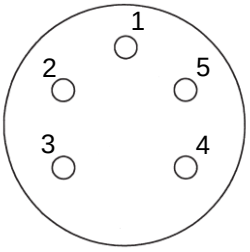


Figure A-1: ***Bulkhead Connector—Face View***

Instrument Bulkhead Connector				Signal Direction	Computer DB-9 Connector		
PIN	WIRE COLOR	LABEL	FUNCTION		PIN	LABEL	FUNCTION
1	Black	GND	Ground	—	5	GND	Ground
2	White	RXD	Received Data	Computer to Instrument	3	TXD	Transmitted Data
4	Green	TXD	Transmitted Data	Instrument to Computer	2	RXD	Received Data

Table A-1: ***Instrument to Computer Connections***

Instrument Bulkhead Connector				Power Supply
PIN	WIRE COLOR	LABEL	FUNCTION	
1	Black	GND	Ground	Ground
3	Red	Power(+)	Instrument Power	12 VDC (nominal)
5	Orange	NC	NC	NC

Table A-2: ***Instrument to Power Supply Connections***

APPENDIX B: Calibrating the Zero Velocities

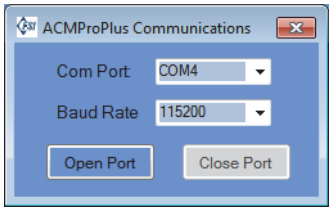
The ACM-PLUS zero velocities should be calibrated periodically, depending on the number of instrument deployment cycles. To calibrate the zero velocities, a test tank filled with water and large enough to completely submerge the instrument is required. A 55-gallon tank is recommended. Preferably the calibration procedure should be performed indoors.

> ***Note:*** *To calibrate the zero velocities, the ACM-PLUS must be connected to your computer, and the computer must be running ACMProPlus. In addition, the Firmware Upgrade/RUN switch on the ACMPlus test cable must be switched to RUN. (See "SECTION 2: Setting up the ACM-PLUS.")*

To calibrate the zero velocities:

1. Set up the test tank indoors in a thermally stable area, shielded from the elements. Let the water stabilize for 24 hours.
2. Place the ACM-PLUS into the test tank with the ACMPlus test cable connected and let it sit for one hour.
3. Choose *Communications* > *ACMProPlus Communications*.

   The ACMProPlus Communications dialog box opens:



4. Click **Open Port**. If this button is highlighted in gray, it is already open. If this is the case, just click **X**.
5. Choose *Calibration* > *Zero Velocities*.

   The Zero Velocities dialog box opens as shown in Figure B-1.

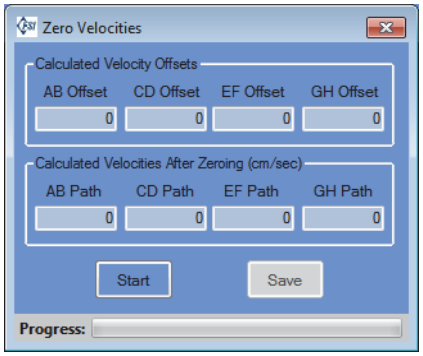
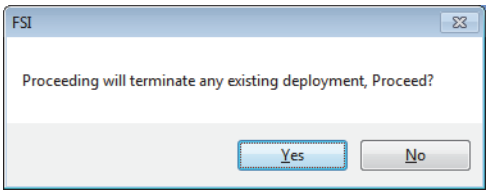


Figure B-1: ***The Zero Velocities Dialog Box***

6. Click **Start**.

   A window opens warning that any existing deployment will be terminated:



7. Click **Yes**.

   The instrument begins the zero velocity calibration process while a progress bar at the bottom of the Zero Velocities dialog box indicates the calibration status. When the calibration is complete, the displays in the Zero Velocities dialog box indicate the zero velocity calibration offsets and the actual velocities for all four velocity paths AB, CD, EF, and GH as shown in Figure B-2.

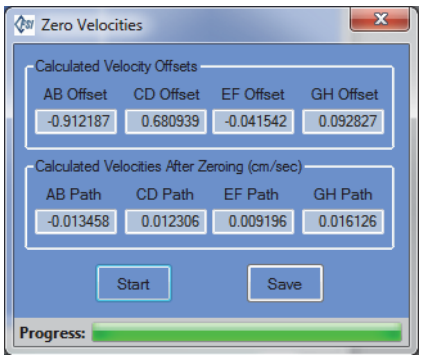


Figure B-2: ***The Zero Velocities Dialog Box, Calibration Complete***

8. Click Save to save the zero velocity calibration constants to the ACM-PLUS memory.

APPENDIX C: ACM-WAVE-PLUS

Like the ACM-PLUS, the Falmouth Scientific 3-Dimensional *Wave* Acoustic Current Meter (ACM-WAVE-PLUS) collects, outputs and stores instantaneous current velocity data in three dimensions along with 3-axis compass data, 2-axis tilt data, temperature data, and data from optional sensors, including an integrated CTD, and in addition, outputs and stores precision pressure data. The ACM-WAVE-PLUS also incorporates a burst mode, which outputs and stores data at one of five sampling rates for specified periods at specified intervals. The burst data can be interleaved with the vector averaged current velocity and tilt data to provide an efficient data collection method. In addition, like the ACM-PLUS, the ACM-WAVE-PLUS is configured and operated using ACMProPlus.

> ***Note:*** *Setting up the ACM-WAVE-PLUS and installing and starting ACMProPlus is the same as that for the ACM-PLUS as described in "SECTION 2: Setting up the ACM-PLUS."*

The ACM-WAVE-PLUS Instrument

The ACM-WAVE-PLUS is an ACM-PLUS that additionally includes a precision micro-machined pressure sensor for measuring wave height. And like the ACM-PLUS, the ACM-WAVE-PLUS is available with a 1.5-ton or a 5-ton 316 stainless steel frame. Shown in Figure C-1 is an ACM-WAVE-PLUS with a 5-ton frame and an optional CTD.

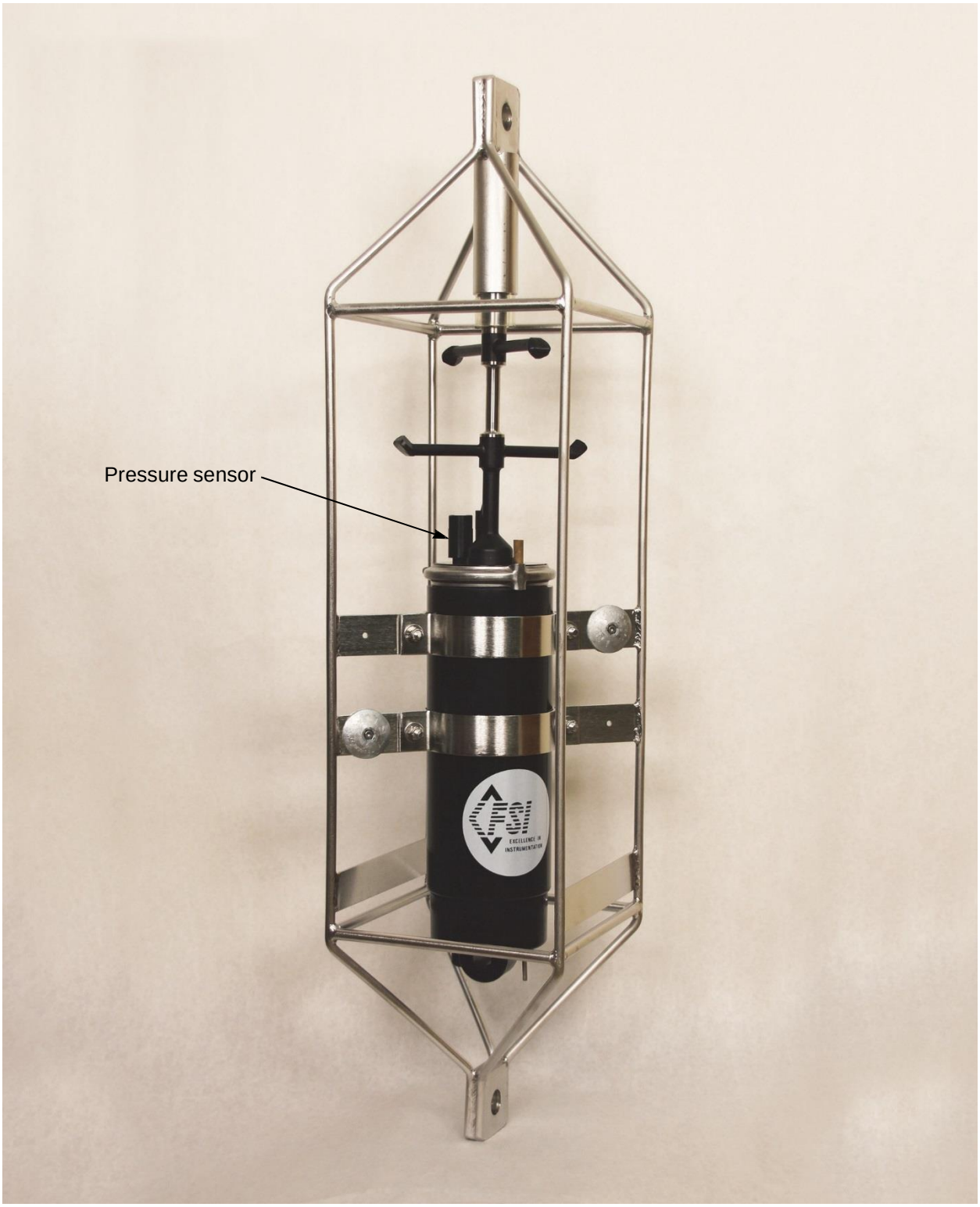


Figure C-1: ***ACM-WAVE-PLUS with 5-Ton Frame and CTD***

Specifications

Below are the general specifications for the ACM-WAVE-PLUS that differ from that of an ACM-PLUS. The specifications listed in "Specifications" on page 1-4 that are *not* listed below are common to both the ACM-PLUS and the ACM-WAVE-PLUS.

Note: *These specifications are subject to change without notice.*

General

Power requirements when battery powered (w/o CTD):	5 VDC @ 64.2 mA (1-Hz sample rate) 5 VDC @ 107.1 mA (5-Hz sample rate)
Power requirements when battery powered (w/ CTD):	5 VDC @ 122.7 mA (1-Hz sample rate) 5 VDC @ 162.4 mA (5-Hz sample rate)
Current draw in sleep mode when battery powered:	1.4 mA
Power requirements when externally powered (w/o CTD):	12 VDC @ 32.9 mA (1-Hz sample rate) 12 VDC @ 52.9 mA (5-Hz sample rate)
Power requirements when externally powered (w/ CTD):	12 VDC @ 56.2 mA (1-Hz sample rate) 12 VDC @ 75.5 mA (5-Hz sample rate)
Current draw in sleep mode when externally powered:	3.83 mA
Depth rating:	20 m, limited by pressure transducer
Sample rate:	1–5 Hz
Weight in air (w/o battery):	7.5 lb (3.4 kg) without CTD; 9.0 lb (4.1 kg) with CTD
Weight in water (w/o battery):	3.0 lb (1.4 kg) *buoyant* without CTD; 2.0 lb (0.9 kg) *buoyant* with CTD

Weight in air (w/ battery): 10.5 lb (4.8 kg) without CTD;
12.0 lb (5.4 kg) with CTD

Weight in water (w/ battery): 2.0 lb (0.9 kg) *buoyant* without CTD;
1.0 lb (0.5 kg) *buoyant* with CTD

Pressure

Sensor type: Precision micro-machined silicon transducer

Range: 0–50 psia (23 m maximum depth)

Accuracy: ±0.01% of full scale

Resolution: 0.145×10^{-3}

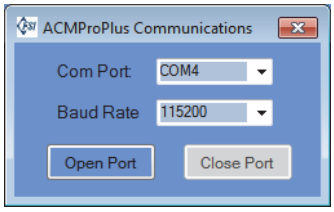
Checking the ACM-WAVE-PLUS

Checking the ACM-WAVE-PLUS requires the same steps as when checking the ACM-PLUS. However, the ACMProPlus Main window now includes the instrument name.

To check the ACM-WAVE-PLUS:

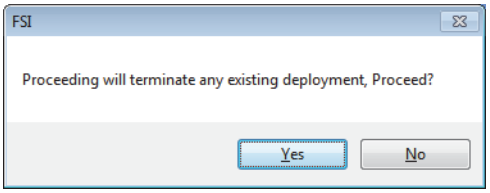
1. Choose *Communications* > *ACMProPlus Communications*.

   The ACMProPlus Communications dialog box opens:



2. Click **Open Port**. If this button is highlighted in gray, it is already open. If this is the case, just click **X**.
3. Choose *Run Instrument* > *Check Instrument*.

   A window opens warning that any existing deployment will be terminated:



4. Click **Yes**.

   ACMProPlus displays the instrument serial number, firmware version number and calibration date in both the Instrument and the Comm Activity displays as shown in Figure C-2. Also in the Instrument Display, the type of serial interface, RS-232 or RS-485, and the instrument name, "ACM-WAVE-PLUS," is displayed. In addition, the Comm Status display indicates when the instrument is sending and receiving information and then indicates Idle when communications are complete.

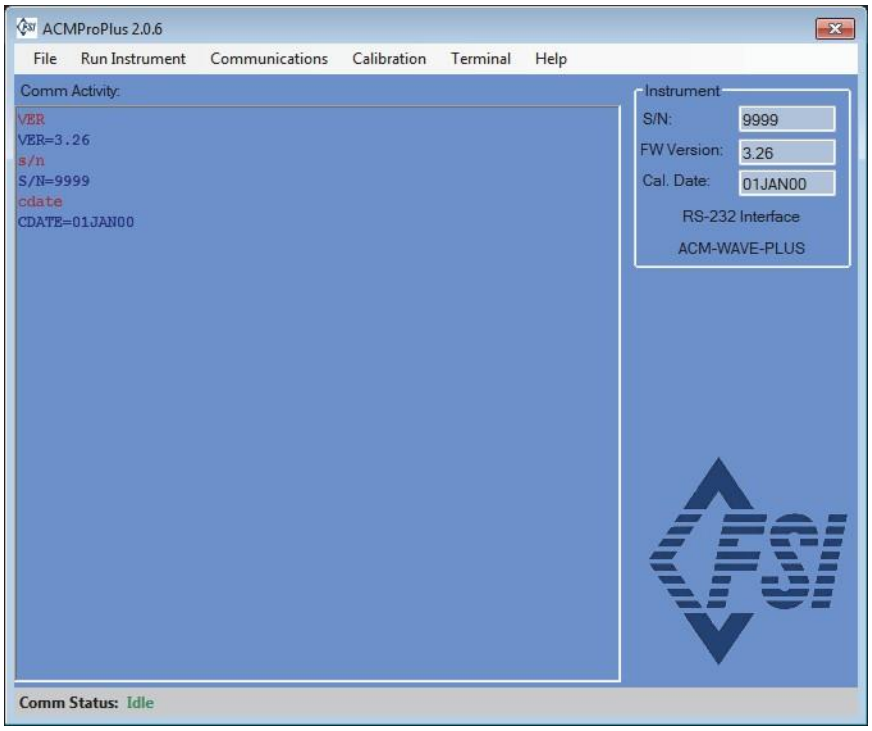


Figure C-2: ***ACMProPlus Main Window after Checking an ACM-WAVE-PLUS***

Configuring the ACM-WAVE-PLUS

Configuring the ACM-WAVE-PLUS requires the same steps as when configuring the ACM-PLUS. However, the Configure and Deploy dialog box provides some addible instrument parameter selections as shown in Figure C-3. Configuring the ACM-WAVE-PLUS requires that you do the following:

- Verify the instrument information. Refer to "Verifying the Instrument Information and Entering the Instrument ID" on page 3-4.
- Enter the user defined deployment parameters and synchronize the instrument's time and date. Refer to "Entering the User Defined Deployment Parameters" on page 3-5. The **Pressure at Depth** scroll box is not included for an ACM-WAVE-PLUS.
- Select the instrument parameters, including the data acquisition mode, run times and sampling rate as described below.
- Select the data parameters to be output and recorded by the instrument. Refer to "Selecting the Data Parameters to Output and Record" on page 3-8.

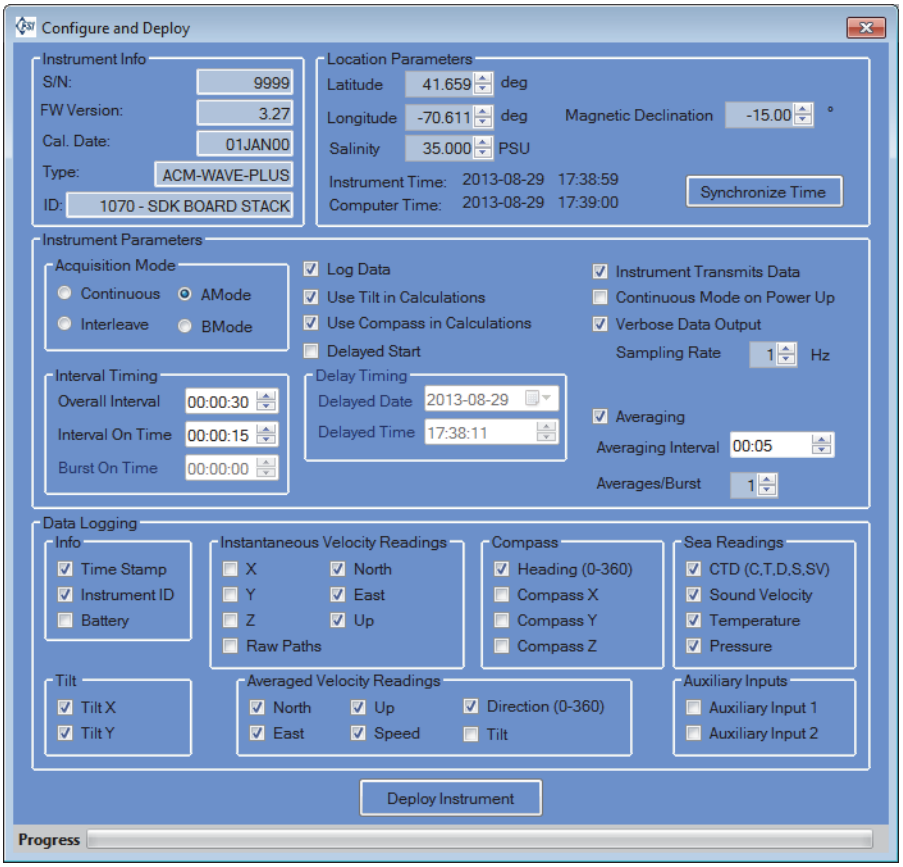


Figure C-3: ***The Configure and Deploy Dialog Box, ACM-WAVE-PLUS***

The instrument parameters are selected in the **Instrument Parameters** area of the Configure and Deploy dialog box.

The instrument parameters are the following:

Acquisition Mode: Provides **Continuous**, **AMode**, **BMode**, and **Interleave** options for the data acquisition mode of the instrument.

In Continuous mode the instrument, once deployed, continuously stores the selected parameters at the selected Sampling Rate, or if Averaging is selected, at the end of every Averaging Interval. Refer to Figure C-4 for the timing diagrams.

In AMode mode the instrument, once deployed, stores the selected parameters at the end of every Averaging Interval for the Interval On Time beginning at the start of every Overall Interval Time. Refer to Figure C-4 for the timing diagram.

In BMode mode the instrument, once deployed, stores the selected parameters at the selected Sampling Rate for the Burst On Time beginning at the start of every Overall Interval Time. Refer to Figure C-5 on page C-10 for the timing diagram.

In Interleaved mode the instrument, once deployed, stores the selected parameters at the end of every Averaging Interval for the Interval On Time and for a specified number of Overall Intervals as determined by Averages/Burst. Then beginning at the start of the next Overall Interval and for that Overall Interval only, stores the selected parameters at the selected Sampling Rate for the Burst On Time. This cycle repeats continuously. Refer to Figure C-5 on page C-10 for the timing diagram.

At all other times the instrument is in low power sleep mode.

Interval Timing: Available only if the **Interleave**, the **AMode**, or the **BMode** option is selected. ‘Provides **Overall Interval**, **Interval On Time**, and **Burst On Time** scroll boxes for setting the instrument run times.

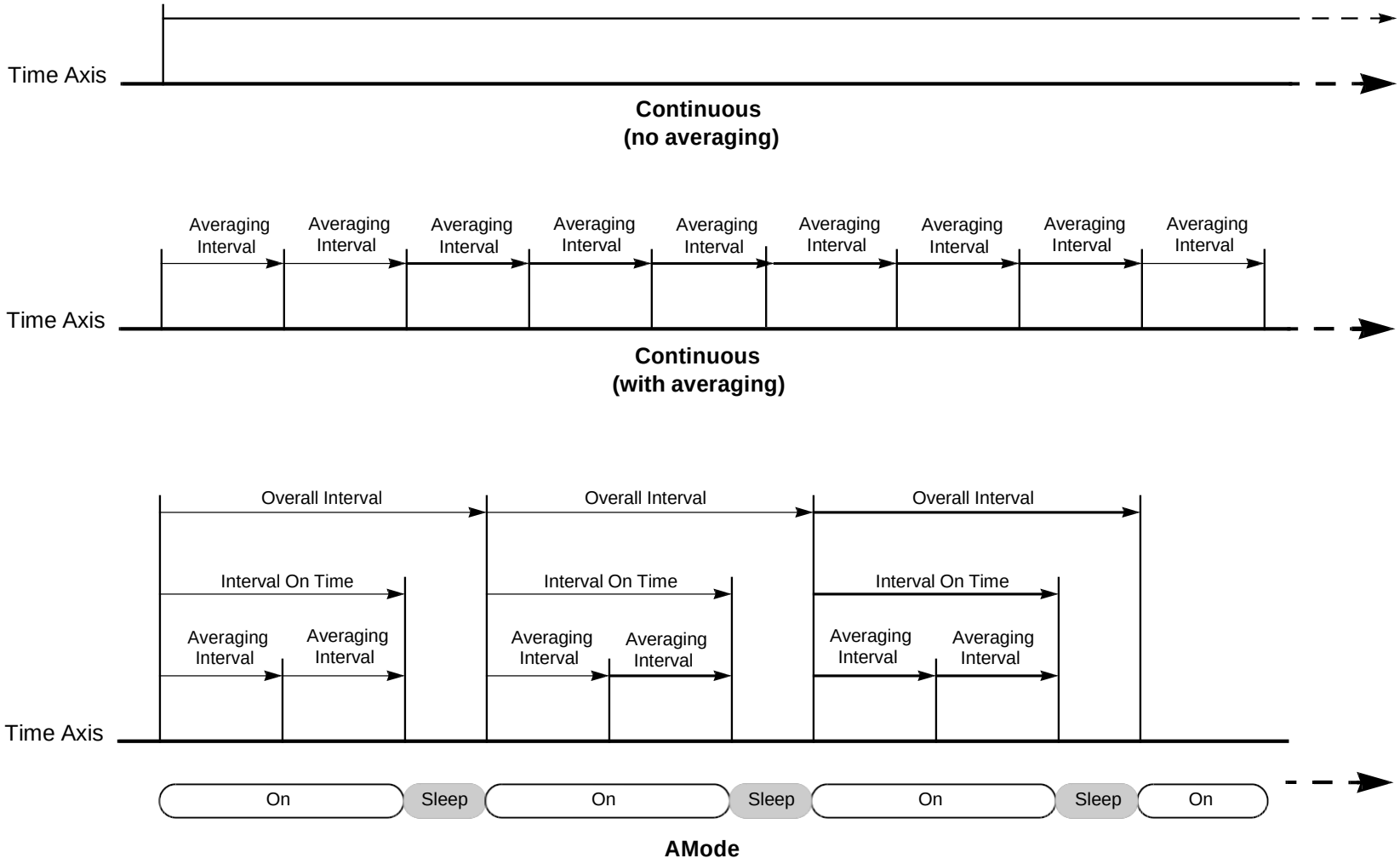


Figure C-4: ***Timing Diagrams for Continuous and AMode Modes***

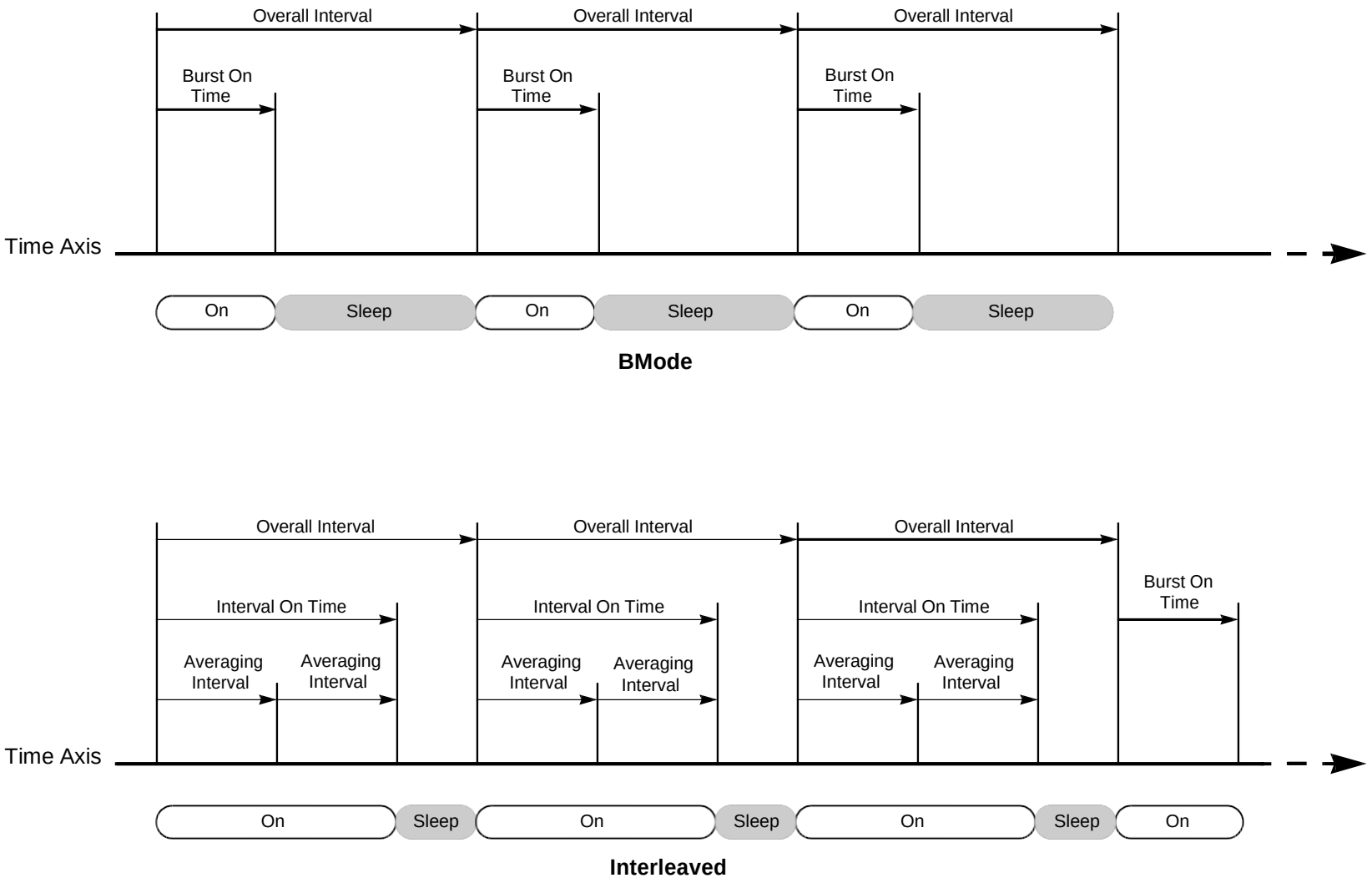


Figure C-5: ***Timing Diagrams for BMode and Interleaved Mode***

The Overall Interval is the time in hours, minutes and seconds between the start of each Interval On Time or Burst On Time.

The Interval On Time is the time in hours, minutes and seconds beginning at the start of an Overall Interval during which the instrument stores the selected parameters at the end of every Averaging Interval.

The Burst On Time is the time in hours, minutes and seconds beginning at the start of an Overall Interval during which the instrument stores the selected parameters at the selected Sampling Rate.

At all other times the instrument is in low power sleep mode.

Averages/Burst: The number of consecutive Overall Intervals the instrument stores the selected parameters at the end of every Averaging Interval for the Interval On time before storing the parameters at the selected sampling rate for the Burst On Time for one Overall Interval.

Note: *If Averaging is selected as described on page C-12, the Interval On Time should be set to an integer number that is evenly divisible by the Averaging Interval. For example, if the Interval On Time is 10 minutes, the Averaging Interval should be set to 1, 2, 5, or 10 minutes.*

Note: *If AMode or Interleaved is selected, then Averaging Interval must be greater than zero.*

Note: *During the AMode and Interleaved mode Averaging Intervals, pressure is always averaged. During the BMode and Interleaved mode Burst On Times, pressure is always instantaneous.*

Delay Timing: Available only if the **Delayed Start** check box is selected. Provides **Delayed Time** and **Delayed Date** scroll boxes for setting the delayed start time and date. The Delayed Date is the date on which the instrument will turn on and begin collecting data at the Delayed Time. The Delayed Time is the time of day on the Delayed Date that the instrument will turn on and begin collecting data.

Log data:	Select to store data to the instrument's memory.
Use Tilt in Calculations:	Select to use the tilt outputs in the current velocity calculations.
Use Compass in Calculations:	Select to use the compass outputs in the current velocity calculations.
Delayed Start:	Select to enable setting of Delayed Date and Delayed Time.
Instrument Transmits Data:	Select to output data when the instrument is deployed. Typically this check box is always selected.
Continuous Mode on Power Up:	Select to have the instrument run in Continuous mode when powered up. This selection is most useful for deployments where serial data is monitored continuously, and the deployment site is subject to power failures.
Verbose Data Output:	Select to enable additional messages to be displayed in the Comm Activity display. Applies to when running in Interval mode or when a delayed start time and date is configured.
Averaging:	Select to include averaging of data. When selected, the **Averaging Interval** scroll box becomes available.
Averaging Interval:	Available only if the **Averaging** check box is selected. The interval in minutes and seconds over which current velocity, tilt and heading are averaged. The range is 00 seconds to 59 minutes and 59 seconds. At the end of every averaging interval, the selected parameters are output on the serial port or logged to memory, or both.
Sampling Rate:	Sampling rate of the instrument. The range is 1 to 5 Hz.

Select or clear the check boxes as required for the deployment. Enter the times directly into the scroll boxes, or separately select the hours, minutes and seconds displays and click the up or down arrow to select the times.

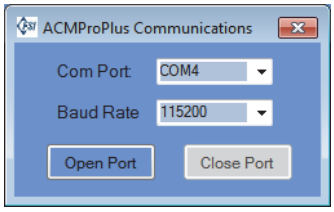
Retrieving and Saving the Data

Retrieving data from the ACM-WAVE-PLUS requires the same steps as when retrieving data from the ACM-PLUS. However, the averaged and continuous data are separate from the burst data.

To retrieve and save the data from the ACM-WAVE-PLUS:

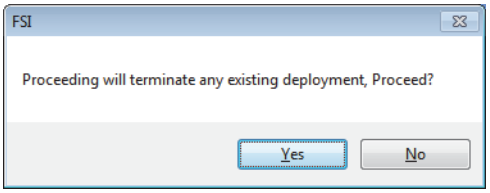
1. Choose *Communications* > *ACMProPlus Communications*.

   The ACMProPlus Communications dialog box opens:



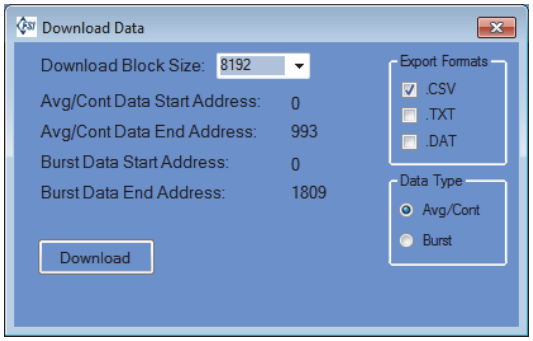
2. Click **Open Port**. If this button is highlighted in gray, it is already open. If this is the case, just click **X**.
3. Choose *Run Instrument* > *Download Data*.

   A window opens warning that any existing deployment will be terminated:



4. Click **Yes**.

   The Download Data dialog box opens:



5. Select the block size for the data in the **Download Block Size** drop-down list box. Typically choose the largest block which is 8192. However, if a radio communications link is involved, you typically should choose the smallest block which is 256.

   The **Avg/Cont Data Start Address** and the **Avg/Cont Data End Address** together indicate the total number of bytes to be downloaded that were recorded during Continuous mode or during the Interval On Time in AMode or Interleave mode.

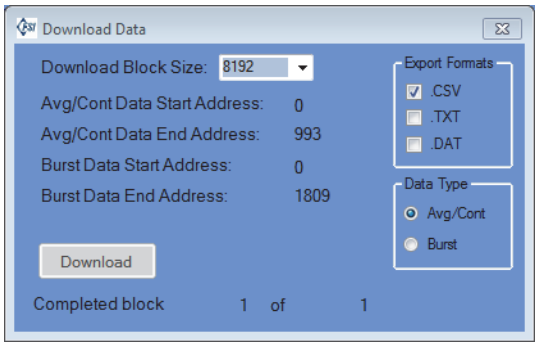
   The **Burst Data Start Address** and the **Burst Data End Address** together indicate the total number of bytes to be downloaded that were recorded during the Burst On Time in BMode or Interleaved mode.

6. Select **Avg/Cont** to download data that were recorded during Continuous mode or during the Interval On Time in AMode or Interleave mode; select **Burst** to download data that were recorded during the Burst On Time in BMode or Interleaved mode.

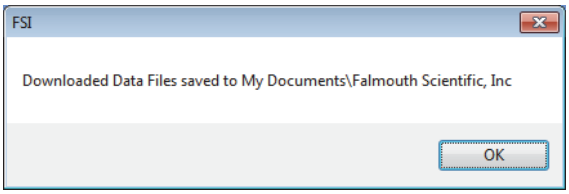
7. Select at least one export format for the downloaded data by selecting one or more of the **.CSV**, **.TXT** or **.DAT** check boxes. A CSV file can be opened in most spreadsheet programs. A TXT file can be opened in most text editors. And a DAT file is an FSI format for use in post processing. This file, too, can be opened in most text editors.

8. Click **Download**.

   The data are downloaded while an indication of the number of blocks downloaded is displayed:



   When all the data are downloaded, a window opens indicating that the data have been saved:



Deploying the ACM-WAVE-PLUS

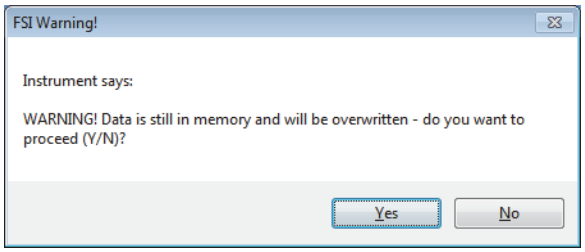
After an ACM-WAVE-PLUS has been configured, it can be deployed under its own internal battery power, and the data can be stored to the instrument's memory for later retrieval. If necessary, however, before deploying the instrument, replace the battery pack. In addition, the battery pack must be degaussed before installing it. (See "SECTION 6: Disassembling and Reassembling the ACM-PLUS and Installing the Battery Pack," for instructions on how to disassemble the instrument and degauss and install the battery pack.)

> ***Note:*** *Because the ACM-WAVE-PLUS includes a lithium battery for memory backup and the real time clock (RTC), which provides the instrument's time and date, replacing the battery pack will not affect the instrument's configuration, stored data or time and date settings.*

To Deploy the ACM-WAVE-PLUS:

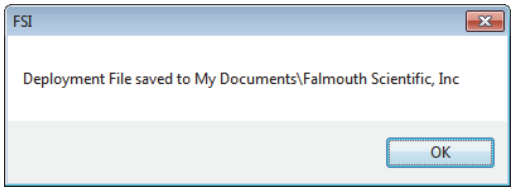
1. Configure the ACM-WAVE-PLUS as described in "Configuring the ACM-WAVE-PLUS" on page C-7.
2. In the Configure and Deploy dialog box, click **Deploy Instrument**.

   A window opens warning that data in memory will be overwritten:



3. If you want to overwrite the data in memory and continue with the deployment, click **Yes**. Otherwise click **X** to abort the deployment without affecting the data.

   The instrument begins the deployment process while a progress bar at the bottom of the Configure and Deploy dialog box indicates the deployment status. When the deployment is complete, a window opens informing you that the deployment file has been saved:



APPENDIX D: WAVE-TIDE-PLUS

Like the ACM-PLUS, the Falmouth Scientific *Wave* and *Tide* Meter (WAVE-TIDE-PLUS) collects, outputs and stores instantaneous precision pressure and temperature data, and data from optional sensors, including an integrated CTD, and in addition, outputs, stores and processes this data. The WAVE-TIDE-PLUS incorporates a burst mode, which outputs and stores data at one of five sampling rates for specified periods at specified intervals. The burst data can be interleaved with averaged sensor data to provide an efficient data collection method. Also, when "wave tide processing" is selected, the WAVE-TIDE-PLUS will perform internal processing on the collected burst mode data providing real-time non-directional wave statistics. In addition, like the ACM-PLUS and ACM-WAVE-PLUS, the WAVE-TIDE-PLUS is configured and operated using ACMProPlus.

Note: *Setting up the WAVE-TIDE-PLUS and installing and starting ACMProPlus is the same as that for the ACM-PLUS as described in "SECTION 2: Setting up the ACM-PLUS."*

The WAVE-TIDE-PLUS Instrument

The WAVE-TIDE-PLUS includes a precision micro-machined pressure sensor for measuring wave height. The WAVE-TIDE-PLUS is supplied with plastic clamps and a 316 stainless steel mounting bar. Shown in Figure D-1 is an WAVE-TIDE-PLUS with an optional CTD.

Figure D-1: ***WAVE-TIDE-PLUS with CTD***

Specifications

Below are the general specifications for the WAVE-TIDE-PLUS that differ from that of an ACM-PLUS. The specifications listed in "Specifications" on page 1-4 that are *not* listed below are common to both the ACM-PLUS and the WAVE-TIDE-PLUS.

Note: *These specifications are subject to change without notice.*

General

Power requirements when battery powered (w/o CTD):	5 VDC @ 50 mA (1-Hz sample rate) 5 VDC @ 83 mA (5-Hz sample rate)
Power requirements when battery powered (w/ CTD):	5 VDC @ 84 mA (1-Hz sample rate) 5 VDC @ 117 mA (5-Hz sample rate)
Current draw in sleep mode when battery powered:	250uA
Power requirements when externally powered (w/o CTD):	12 VDC @ 30 mA (1-Hz sample rate) 12 VDC @ 45 mA (5-Hz sample rate)
Power requirements when externally powered (w/ CTD):	12 VDC @ 45 mA (1-Hz sample rate) 12 VDC @ 60 mA (5-Hz sample rate)
Current draw in sleep mode when externally powered:	3.83 mA
Depth rating:	20 m, limited by pressure transducer
Sample rate:	1–5 Hz
Weight in air (w/o battery):	6.5 lb (3.4 kg) without CTD; 8.0 lb (4.1 kg) with CTD
Weight in water (w/o battery):	3.0 lb (1.4 kg) *buoyant* without CTD; 2.0 lb (0.9 kg) *buoyant* with CTD

Weight in air (w/ battery): 9.5 lb (4.8 kg) without CTD;
11.0 lb (5.4 kg) with CTD

Weight in water (w/ battery): 2.0 lb (0.9 kg) *buoyant* without CTD;
1.0 lb (0.5 kg) *buoyant* with CTD

Pressure

Sensor type: Precision micro-machined silicon transducer

Range: 0–50 psia (23 m maximum depth)

Accuracy: ±0.01% of full scale

Resolution: 0.145×10^{-3}

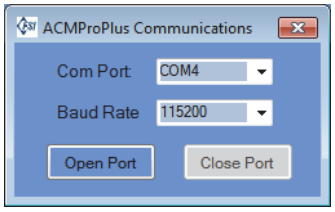
Checking the WAVE-TIDE-PLUS

Checking the WAVE-TIDE-PLUS requires the same steps as when checking the ACM-PLUS. However, the ACMProPlus Main window now includes the instrument name.

To check the WAVE-TIDE-PLUS:

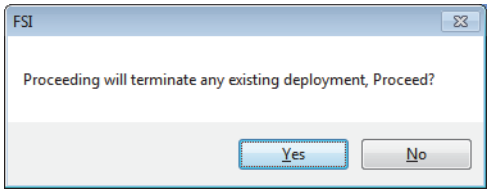
1. Choose *Communications* > *ACMProPlus Communications*.

   The ACMProPlus Communications dialog box opens:



2. Click **Open Port**. If this button is highlighted in gray, it is already open. If this is the case, just click **X**.
3. Choose *Run Instrument* > *Check Instrument*.

   A window opens warning that any existing deployment will be terminated:



4. Click **Yes**.

   ACMProPlus displays the instrument serial number, firmware version number and calibration date in both the Instrument and the Comm Activity displays as shown in Figure D-2. Also in the Instrument Display, the type of serial interface, RS-232 or RS-485, and the instrument name, "WAVE-TIDE-PLUS," is displayed. In addition, the Comm Status display indicates when the instrument is sending and receiving information and then indicates Idle when communications are complete.

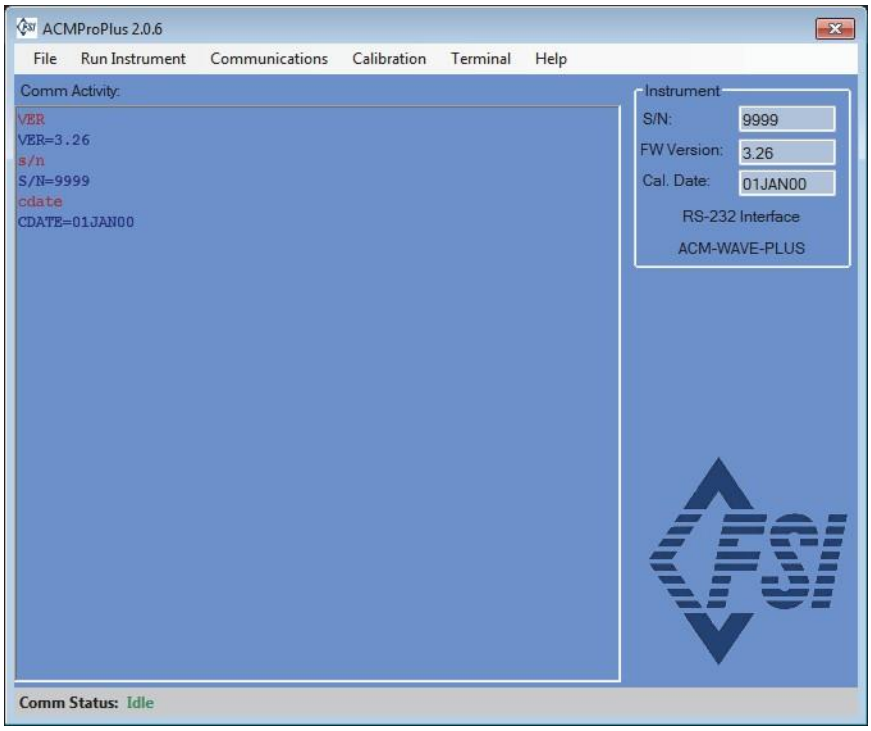


Figure D-2: ***ACMProPlus Main Window after Checking an WAVE-TIDE-PLUS***

Configuring the WAVE-TIDE-PLUS

Configuring the WAVE-TIDE-PLUS requires the same steps as when configuring the ACM-PLUS. However, the Configure and Deploy dialog box provides some addible instrument parameter selections as shown in Figure D-3. Configuring the WAVE-TIDE-PLUS requires that you do the following:

- Verify the instrument information. Refer to “Verifying the Instrument Information and Entering the Instrument ID” on page 3-4.
- Enter the user defined deployment parameters and synchronize the instrument’s time and date. Refer to “Entering the User Defined Deployment Parameters” on page 3-5. The **Pressure at Depth** scroll box is not included for an WAVE-TIDE-PLUS.
- Select the instrument parameters, including the data acquisition mode, run times and sampling rate as described below.
- Select the data parameters to be output and recorded by the instrument. Refer to “Selecting the Data Parameters to Output and Record” on page 3-8.

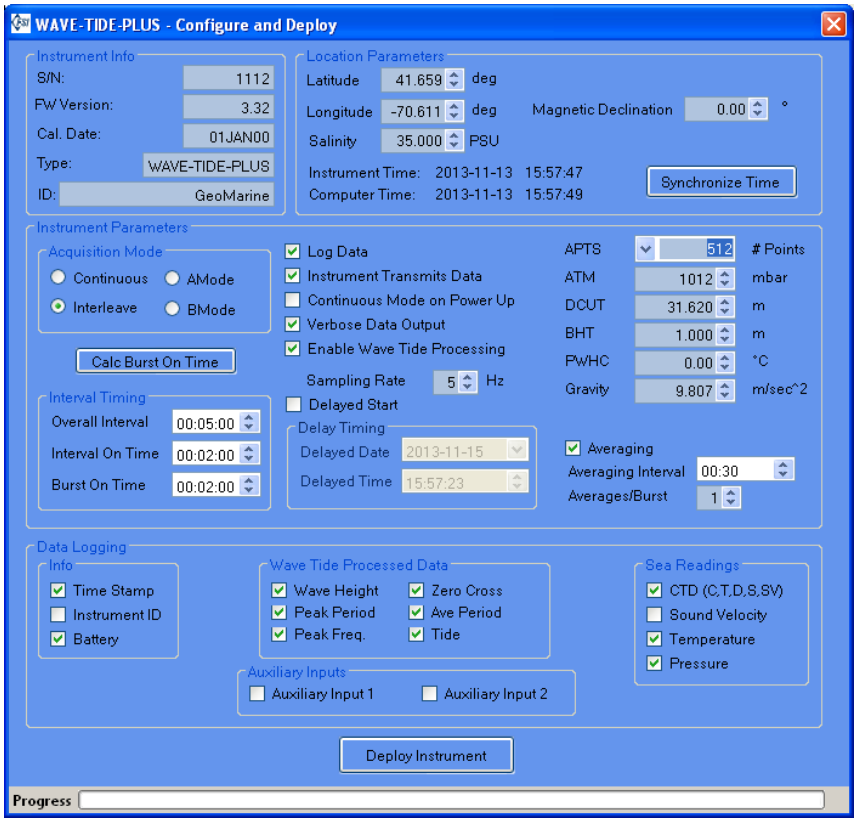


Figure D-3: ***The Configure and Deploy Dialog Box, WAVE-TIDE-PLUS***

The instrument parameters are selected in the **Instrument Parameters** area of the Configure and Deploy dialog box.

The instrument parameters are the following:

Acquisition Mode: Provides **Continuous**, **AMode**, **BMode**, and **Interleave** options for the data acquisition mode of the instrument.

In Continuous mode the instrument, once deployed, continuously stores the selected parameters at the selected Sampling Rate, or if Averaging is selected, at the end of every Averaging Interval. Refer to Figure D-4 for the timing diagrams.

In AMode mode the instrument, once deployed, stores the selected parameters at the end of every Averaging Interval for the Interval On Time beginning at the start of every Overall Interval Time. Refer to Figure D-4 for the timing diagram.

In BMode mode the instrument, once deployed, stores the selected parameters at the selected Sampling Rate for the Burst On Time beginning at the start of every Overall Interval Time. Refer to Figure D-5 on page D-10 for the timing diagram.

In Interleaved mode the instrument, once deployed, stores the selected parameters at the end of every Averaging Interval for the Interval On Time and for a specified number of Overall Intervals as determined by Averages/Burst. Then beginning at the start of the next Overall Interval and for that Overall Interval only, stores the selected parameters at the selected Sampling Rate for the Burst On Time. This cycle repeats continuously. Refer to Figure D-5 on page D-10 for the timing diagram.

At all other times the instrument is in low power sleep mode.

Interval Timing: Available only if the **Interleave**, the **AMode**, or the **BMode** option is selected. ‘Provides **Overall Interval**, **Interval On Time**, and **Burst On Time** scroll boxes for setting the instrument run times.

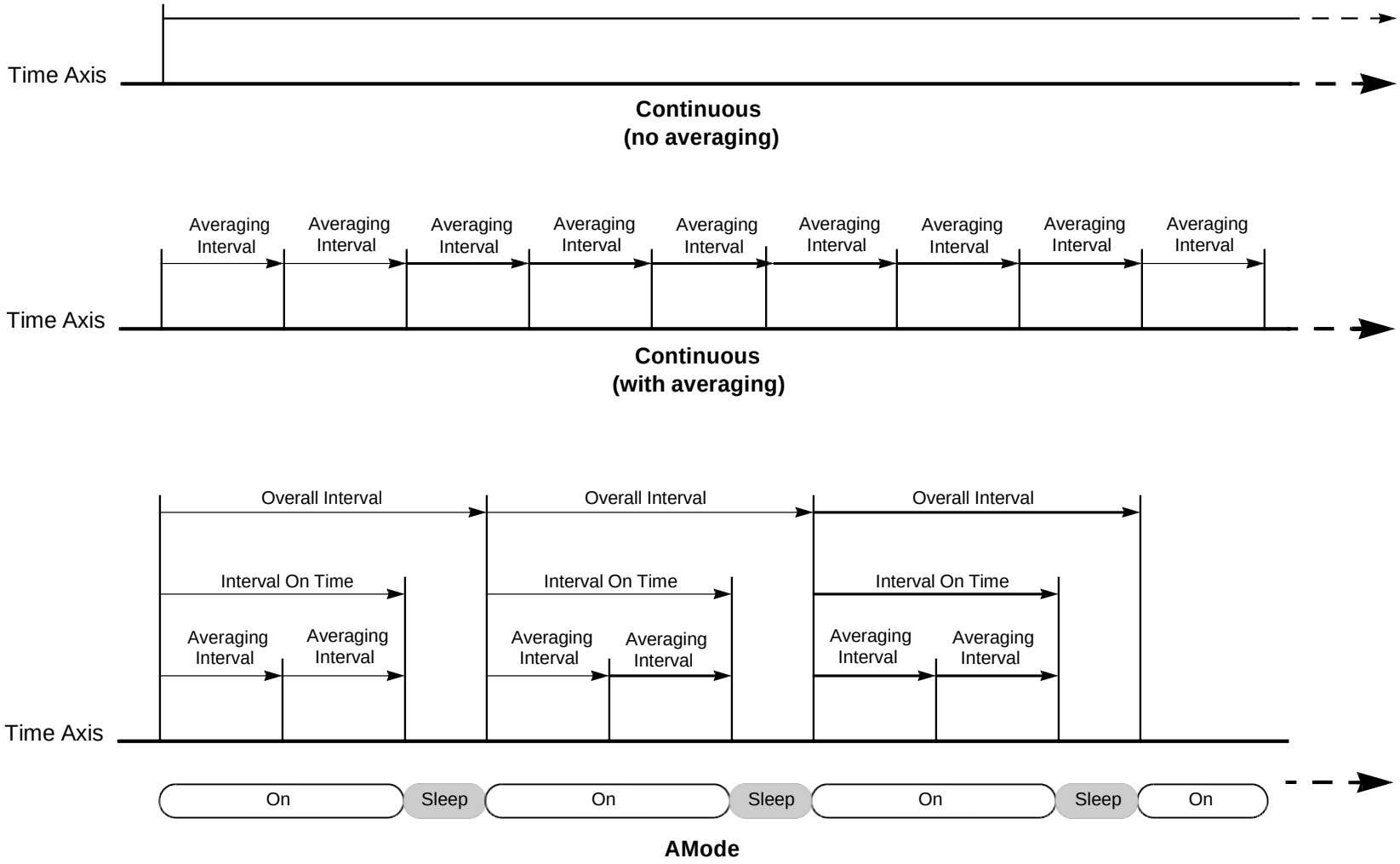


Figure D-4: ***Timing Diagrams for Continuous and AMode Modes***

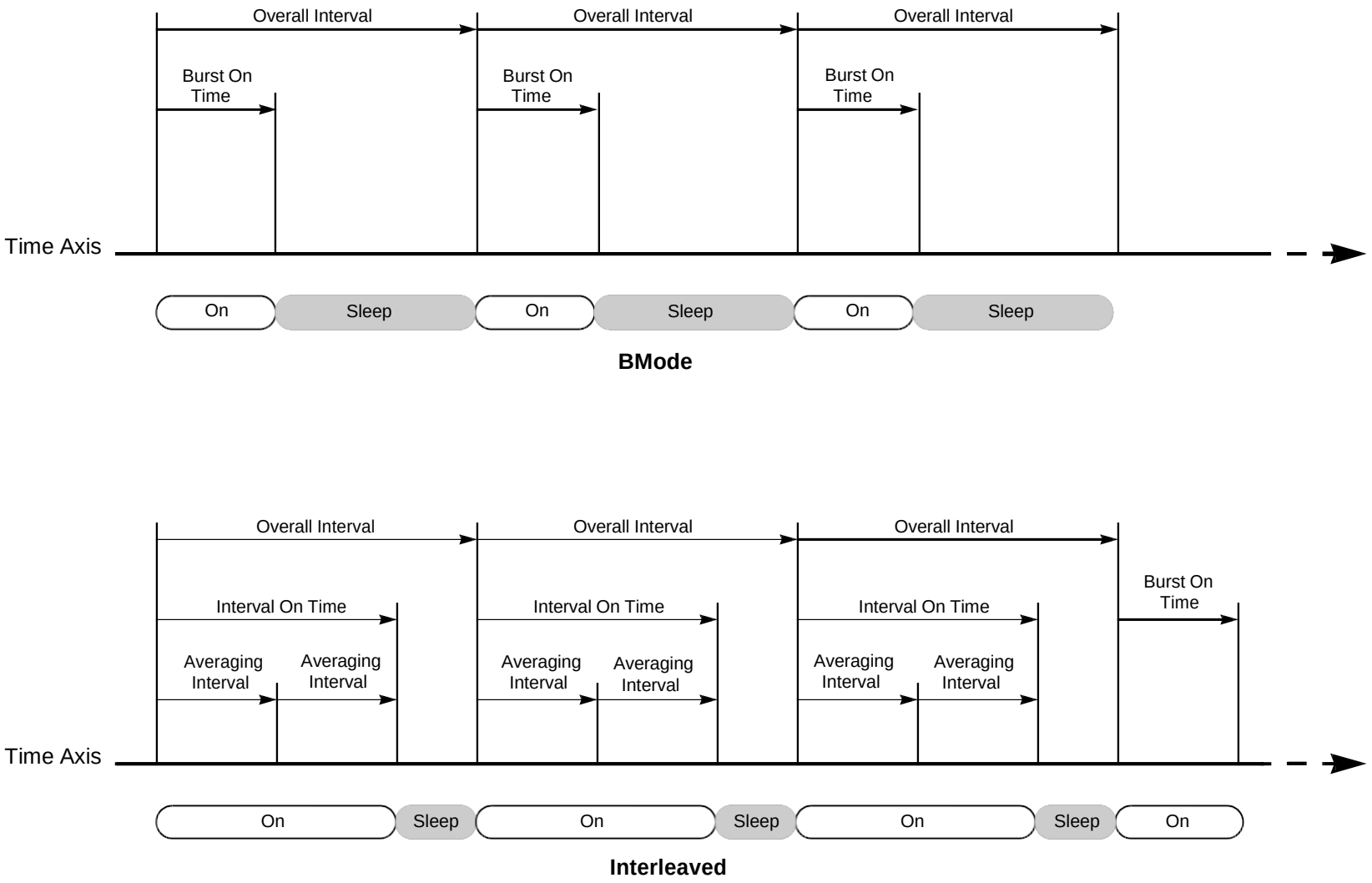


Figure D-5: ***Timing Diagrams for BMode and Interleaved Mode***

The Overall Interval is the time in hours, minutes and seconds between the start of each Interval On Time or Burst On Time.

The Interval On Time is the time in hours, minutes and seconds beginning at the start of an Overall Interval during which the instrument stores the selected parameters at the end of every Averaging Interval.

The Burst On Time is the time in hours, minutes and seconds beginning at the start of an Overall Interval during which the instrument stores the selected parameters at the selected Sampling Rate.

At all other times the instrument is in low power sleep mode.

Averages/Burst: The number of consecutive Overall Intervals the instrument stores the selected parameters at the end of every Averaging Interval for the Interval On time before storing the parameters at the selected sampling rate for the Burst On Time for one Overall Interval.

Note: *If Averaging is selected as described on page D-12, the Interval On Time should be set to an integer number that is evenly divisible by the Averaging Interval. For example, if the Interval On Time is 10 minutes, the Averaging Interval should be set to 1, 2, 5, or 10 minutes.*

Note: *If AMode or Interleaved is selected, then Averaging Interval must be greater than zero.*

Note: *During the AMode and Interleaved mode Averaging Intervals, pressure is always averaged. During the BMode and Interleaved mode Burst On Times, pressure is always instantaneous.*

Delay Timing: Available only if the **Delayed Start** check box is selected. Provides **Delayed Time** and **Delayed Date** scroll boxes for setting the delayed start time and date. The Delayed Date is the date on which the instrument will turn on and begin collecting data at the Delayed Time. The Delayed Time is the time of day on the Delayed Date that the instrument will turn on and begin collecting data.

Log data: Select to store data to the instrument's memory.

Instrument Transmits Data: Select to output data when the instrument is deployed. Typically this check box is always selected.

Continuous Mode on Power Up: Select to have the instrument run in Continuous mode when powered up. This selection is most useful for deployments where serial data is monitored continuously, and the deployment site is subject to power failures.

Verbose Data Output: Select to enable additional messages to be displayed in the Comm Activity display. Applies to when running in Interval mode or when a delayed start time and date is configured.

Enable Wave Tide Processing: Select to enable internal processing of the burst pressure data. Processed wave statistics data will be stored and output via the serial port.

Sampling Rate: Sampling rate of the instrument. The range is 1 to 5 Hz.

Delayed Start: Select to enable setting of Delayed Date and Delayed Time.

APTS: Number of burst mode analysis points for internal wave processing. Select 512, 1024 or 2048 points. Select (OBTIME) X (SRATE) to equal APTS. Example: for an sample rate of 5Hz and APTS = 2048, set OBTIME to 2048/5 = 409.6 sec or 6 min 50 sec.

ATM: Local atmospheric pressure in dBar.

BHT : Instrument height off bottom. If set to zero no depth correction will be used in internal wave processing

Gravity: Local gravity. The Latitude setting in the Local Parameters section is used to calculate local gravity. If the Latitude setting is set to zero the default setting of 9.80665 m/s^2 is used

Averaging: Select to include averaging of data. When selected, the **Averaging Interval** scroll box becomes available.

Averaging Interval: Available only if the **Averaging** check box is selected. The interval in minutes and seconds over which current velocity, tilt and heading are averaged. The range is 00 seconds to 59 minutes and 59 seconds. At the end of every averaging interval, the selected parameters are output on the serial port or logged to memory, or both.

Select or clear the check boxes as required for the deployment. Enter the times directly into the scroll boxes, or separately select the hours, minutes and seconds displays and click the up or down arrow to select the times.

Selecting the Data Parameters to Output and Record

The data parameters to output and record are selected in the **Data Logging** area of the Configure and Deploy dialog box which is composed of four separate sections as shown in Figure D-3 on page D-7. The selectable parameters include instrument info and time stamp, wave and tide processed data parameters, sea readings, and the auxiliary analog input channels.

Note: *For each of the parameter names listed in the following pages, an abbreviated name is included in parenthesis. Except for Instrument ID (INSID), these names are shown in the column headings when viewing downloaded data. (See "Column Heading Definitions" on page 5-6 for the column headings that can be viewed and their definitions.) These abbreviations are also displayed as "Tool Tips" when holding the pointer over the parameter name in the Configure and Deploy dialog box.*

The **Info** section enables selection of the time stamp, the instrument ID and the battery voltage:

Time Stamp (TSTMP): The time and date for each record.

Instrument ID (INSID): The entered instrument ID for all the records.

Battery (BATT): The battery voltage in volts for each record.

The **Wave Tide Processed Data** section enables selection of the wave statistic parameters generated by the internal processing of the Burst data when enabled

Wave Height (Hmo): Significant wave height in Meters. Significant wave height is defined as the mean wave height trough to crest of the highest third of the waves (H1/3).

Peak Period(Tp): Peak Period in seconds. This is the period of the

highest energy waves in the total wave spectrum.

Peak Freq (Fp): Peak Frequency in Hertz (Hz). Peak Frequency is the inverse of Peak Period.

Zero Cross (Tzf): Mean zero crossing in seconds calculated from spectral moments.

Ave Period (Tavg): Average period in seconds. Calculated for spectral moments

Tide (Tide): The height of the water column above the pressure sensor corrected by BHT. ATM is also removed from the calculation.

The **Sea Readings** section enables selection of the sensor outputs:

CTD (CTD): The five CTD outputs of conductivity in mmho/cm, temperature in °C and pressure in dbar. (with optional CTD only)

Sound Velocity (SV): The sound velocity in water in m/sec.

Temperature (STEMP): The water temperature in °C.

Pressure (SPRES): The water pressure in mbar.

The **Auxiliary Inputs** section enables selection of the two auxiliary analog channel outputs:

Auxiliary Input 1 (AUX1): The Auxiliary Input 1 output.

Auxiliary Input 2 (AUX2): The Auxiliary Input 2 output.

Select or clear the check boxes as required for the deployment.

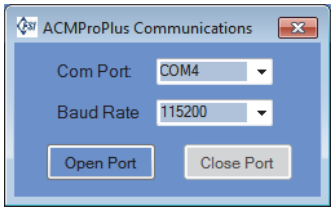
Retrieving and Saving the Data

Retrieving data from the WAVE-TIDE-PLUS requires the same steps as when retrieving data from the ACM-PLUS. However, the averaged and continuous data are separate from the burst data and the processed wave data.

To retrieve and save the data from the WAVE-TIDE-PLUS:

1. Choose *Communications* > *ACMProPlus Communications*.

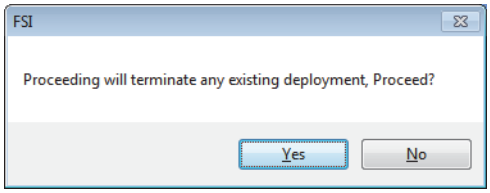
   The ACMProPlus Communications dialog box opens:



2. Click **Open Port**. If this button is highlighted in gray, it is already open. If this is the case, just click **X**.

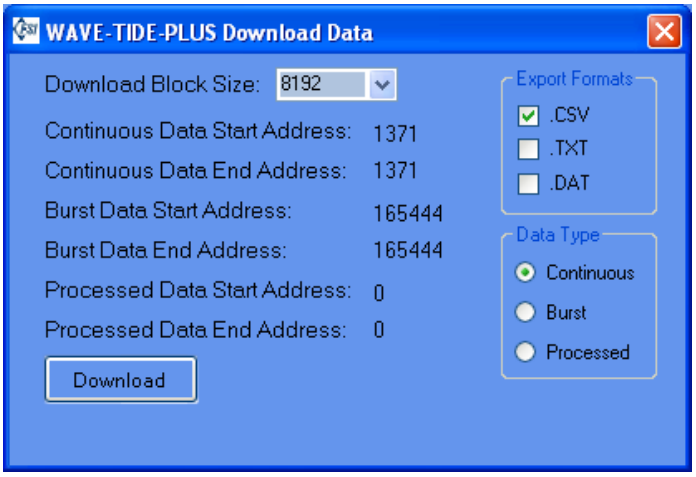
3. Choose *Run Instrument* > *Download Data*.

   A window opens warning that any existing deployment will be terminated:



4. Click **Yes**.

   The Download Data dialog box opens:



5. Select the block size for the data in the **Download Block Size** drop-down list box. Typically choose the largest block which is 8192. However, if a radio communications link is involved, you typically should choose the smallest block which is 256.

   The **Avg/Cont Data Start Address** and the **Avg/Cont Data End Address** together indicate the total number of bytes to be downloaded that were recorded during Continuous mode or during the Interval On Time in AMode or Interleave mode.

   The **Burst Data Start Address** and the **Burst Data End Address** together indicate the total number of bytes to be downloaded that were recorded during the Burst On Time in BMode or Interleaved mode.

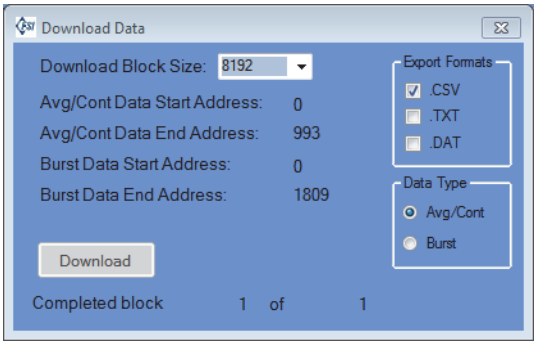
   The **Processed Data Start Address** and the **Processed Data End Address** together indicate the total number of bytes to be downloaded that were recorded at the end of the Burst On Time in BMode or Interleaved mode when Wave Tide Processing is enabled.

6. Select **Avg/Cont** to download data that were recorded during Continuous mode or during the Interval On Time in AMode or Interleave mode; select **Burst** to download data that were recorded during the Burst On Time in BMode or Interleaved mode; select **Processed** to download data that were recorded at the end of the Burst On Time in BMode or Interleaved mode.

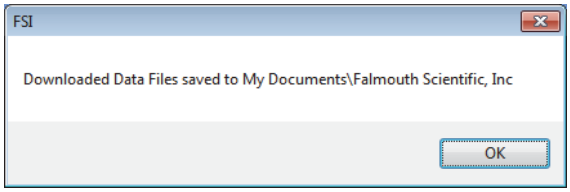
7. Select at least one export format for the downloaded data by selecting one or more of the **.CSV**, **.TXT** or **.DAT** check boxes. A CSV file can be opened in most spreadsheet programs. A TXT file can be opened in most text editors. And a DAT file is an FSI format for use in post processing. This file, too, can be opened in most text editors.

8. Click **Download**.

   The data are downloaded while an indication of the number of blocks downloaded is displayed:



   When all the data are downloaded, a window opens indicating that the data have been saved:


FSI
Downloaded Data Files saved to My Documents\Falmouth Scientific, Inc
OK

Deploying the WAVE-TIDE-PLUS

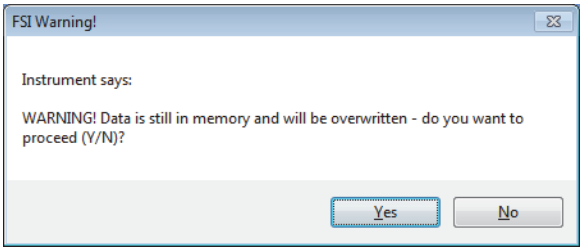
After a WAVE-TIDE-PLUS has been configured, it can be deployed under its own internal battery power, and the data can be stored to the instrument's memory for later retrieval. If necessary, however, before deploying the instrument, replace the battery pack. In addition, the battery pack must be degaussed before installing it. (See "SECTION 6: Disassembling and Reassembling the ACM-PLUS and Installing the Battery Pack," for instructions on how to disassemble the instrument and degauss and install the battery pack.)

> ***Note:*** *Because the WAVE-TIDE-PLUS includes a lithium battery for memory backup and the real time clock (RTC), which provides the instrument's time and date, replacing the battery pack will not affect the instrument's configuration, stored data or time and date settings.*

To Deploy the WAVE-TIDE-PLUS:

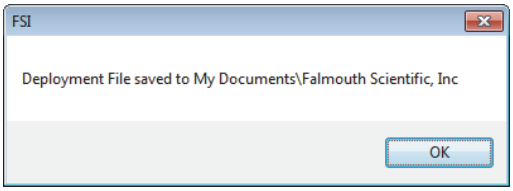
1. Configure the WAVE-TIDE-PLUS as described in "Configuring the ACM-WAVE-PLUS" on page D-7.
2. In the Configure and Deploy dialog box, click **Deploy Instrument**.

   A window opens warning that data in memory will be overwritten:



3. If you want to overwrite the data in memory and continue with the deployment, click **Yes**. Otherwise click **X** to abort the deployment without affecting the data.

   The instrument begins the deployment process while a progress bar at the bottom of the Configure and Deploy dialog box indicates the deployment status. When the deployment is complete, a window opens informing you that the deployment file has been saved:



Theory of Operation : Non Directional Internal Pressure Analysis Steps

1. Determine the average of the data set. (one data set is the determined by the APTS setting in the Properties dialog and is either 512, 1024, 2048 data points)

2. Use the average pressure value as the instrument measurement depth (for depth correction).

3. Calculate the water depth by the BHT (Height off the Bottom) setting from the Properties dialog to the instrument measurement depth.

4. Next, determine the number of data segments within the data set using a data segment length of 512 points and 50% overlapping. Example: Nseg=(1024 / (512 – 512 / 2)) –1 = 3 segments.

5. Apply the following steps to every data segment and accumulate the resultant spectrum:

a. Remove the mean from this segment

b. Remove any linear trend

c. Apply a 10% cosine taper to the pressure data

d. Maintain variance

e. Perform a 512-point FFT

f. Calculate the magnitude of each frequency bin until Nyquist

g. Accumulate each frequency bin with last segment frequency bin Sxx

6. Divide each frequency bin by the number of segments for this data set, Sxx.

7. If depth correction is NOT used go to step 10, otherwise go to step 8.

8. Determine wave number in radians/meter from the sampling frequency and the water depth.

9. Apply the depth correction to the spectrum series, Sxx.

10. Calculate the Wave Height using the following:

$$Hmo = 4.0 * \sqrt{\sum_{n=0}^{255} Sxx(n)} \quad \text{(meters)}$$

□ *n*

11. Search Sxx to determine the peak frequency and peak period.

12. Calculate the spectral moments m0, m1, m2.

$$m0 = \sum_{n=0}^{255} Sxx(n), \qquad m1 = \sum_{n=0}^{255} f(n)*Sxx(n), \qquad m2 = \sum f^2(n) * Sxx(n)$$

13. Calculate the average wave period, Tavg = m0 / m1

14. Calculate the zero-crossing period, Tzero = *m*0 /*m*2

Tide is calculated by taking the last 60 seconds of pressure readings and averaging them. The actual number or readings will depend on SRATE.

APPENDIX E: Warranty, Liability and RMA Return Procedure

Falmouth Scientific, Inc. Limited Warranty

Falmouth Scientific, Inc. (FSI) guarantees its products to be free from defects in materials and workmanship for a period of one year from the date of shipment. In the event a product malfunctions during this period, FSI's obligation is limited to the repair or replacement, at FSI's option, of any product returned to the FSI factory. Products found defective should be returned to the factory freight prepaid and carefully packed, as the customer will be responsible for any damage during shipment.

Repairs or replacements, parts, labor, and return shipment under this warranty will be at no cost to the customer. This warranty is void if, in FSI's opinion, the product has been damaged by accident or mishandled, altered, or repaired by the customer, where such treatment has affected its performance or reliability. In the event of such mishandling, all costs for repair and return freight will be charged to the customer. All products supplied by FSI that are designed for use under hydrostatic loading have been certified by actual pressure testing prior to shipment. Any damage that occurs as a direct result of flooding is NOT covered by this warranty.

If a product is returned for warranty repair and no defect is found, the customer will be charged a diagnostic fee plus all shipping costs. Incidental or consequential damages or costs incurred as a result of a product's malfunction are not the responsibility of FSI.

Equipment not manufactured by FSI is supported only to the extent of the original equipment manufacturer's (OEM) original warranties. All OEM sensors that utilize electrodes (oxygen cartridges, pH, ORP, etc.) are warranted at the time of shipment, and shall perform upon initial installation within stated specifications. If the product proves to be defective within the OEM's warranty, FSI will replace the product or defective part with a similar model, product or part, but only to the extent that the OEM warrants.

All returned products must be accompanied by a Returned Material Authorization (RMA) number issued by FSI. Shipments without an RMA number will not be accepted.

Liability

FSI shall not be liable for incidental or consequential damages, injuries, or losses as a result of the installation, testing, operation, or servicing of FSI products.

RMA Return Procedure

Before returning any equipment to FSI, you must contact FSI and obtain a Returned Material Authorization (RMA) number. The RMA number assists FSI in identifying the origin and tracking the location of returned items.

When returning items to FSI from outside the United States, follow the checklist presented below to prevent any delays or additional costs.

- Include with all shipments two copies of your commercial invoice showing the value of the items and the reason you are returning them. Whenever possible, send copies of the original export shipping documents with the consignment.
- Route via courier (FedEx or UPS).
- If there is more than one item per consignment, include a packing list with the shipment. It is acceptable to combine the commercial invoice and packing list with the contents of each carton, clearly numbered and identified on the commercial invoice.
- If it is necessary to ship via air freight, contact FSI for specific freight forwarding instructions. You will be charged for customs clearance and inbound freight.
- Insure the items for their full value.
- Refer to the FSI issued RMA number on all documents and correspondence.
- Prepay the freight.